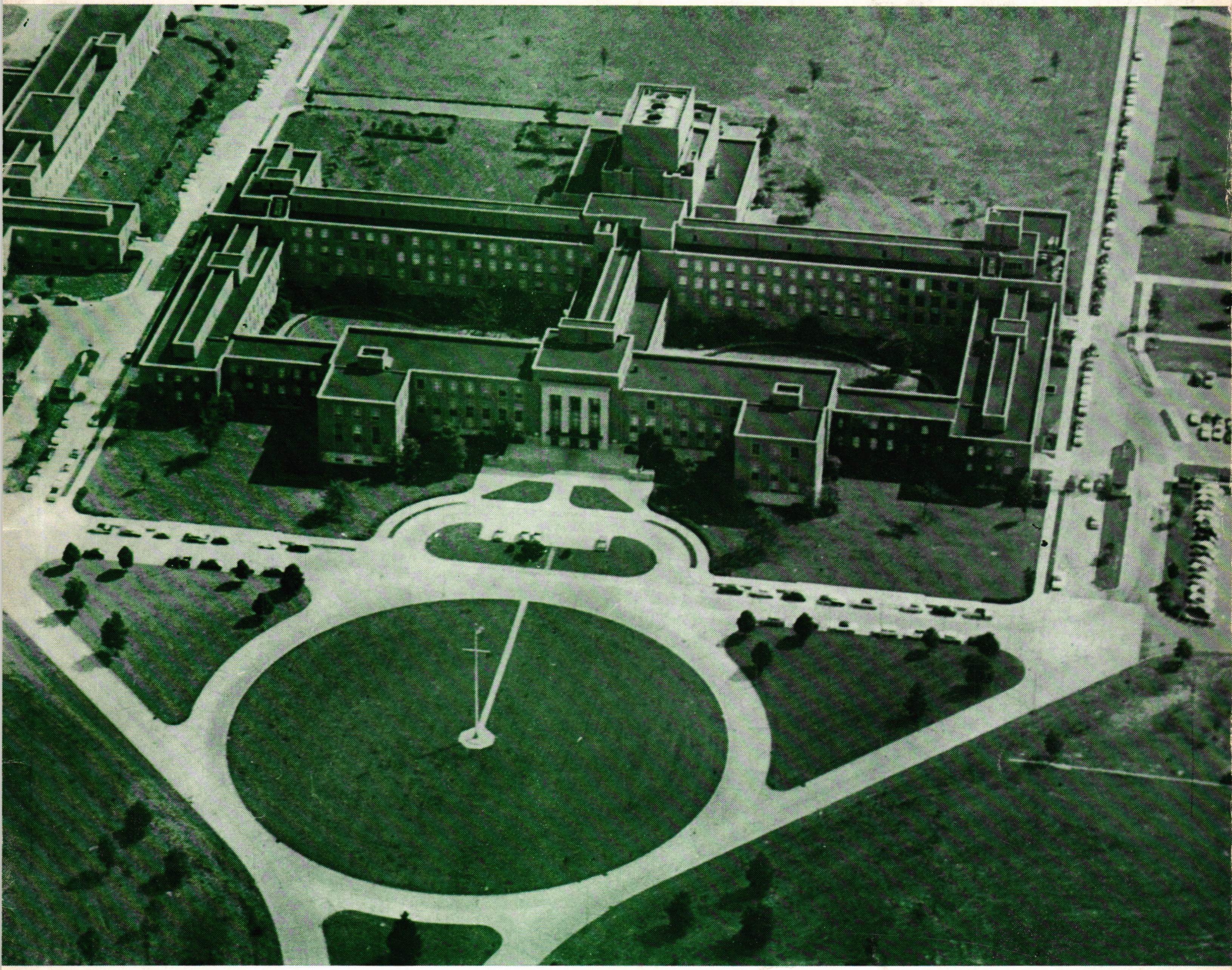
the Mecheleciv

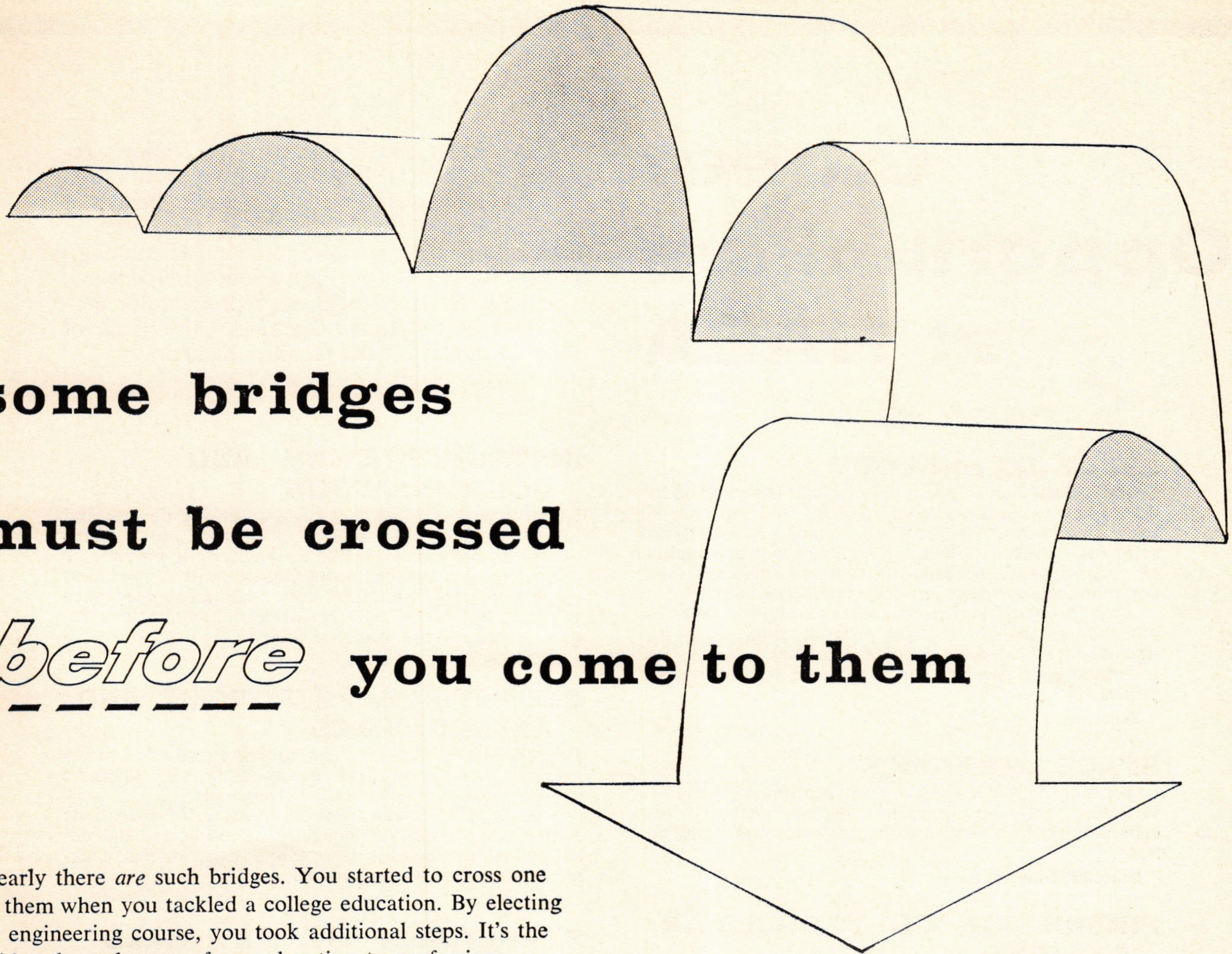
VOL. 18 MAY 1959 NO. 6

School of Engineering
The George Washington
University



THE NAVAL ORDNANCE LABORATORY

MAY 1959



some bridges must be crossed *before* you come to them

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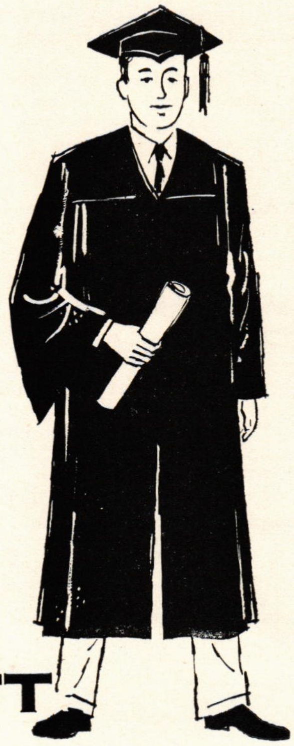

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The Mechelecív

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In This Issue

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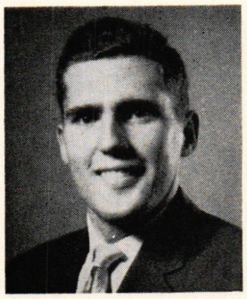
FROM THE EDITOR'S DESK

with Woody Everett



More about the salaries of engineers: U.S. News and World Report, April 13, states that the average offer for engineers and scientists is up to $500 to $510 per month; bear in mind that the starting offers last June were $475 per month on the average and that just last Fall the average starting salaries were $480 per month. It is interesting to note that the starting salaries of young lawyers range from $400 a month to $525 per month. By graphical indications, the December-January Northwest Professional Engineer showed the relationship of various experience. The trend ran something like this for engineers—no experience; from $425 in the 5% percentile to $625 in the 90% percentile—5 years experience; from $510 in the 5% percentile to $1025 in the 90% percentile (the percentiles are the "quality" of the particular engineers).

* * *

Cyril Ainsworth, Deputy Managing Director, American Standards Association, at a dinner observing National Engineers Week, stated that American economy could save at least $4 billion a year if all those who neglect standardization would begin to observe it. Seems that American industry with all its mass production techniques is still trying to "specialize" too many items.

* * *

On February 26 in the annual Westinghouse Scientific Talent Search, 40 high school seniors were picked from a field of over 28,000 as the "nation's most promising future scientists." The 40 chosen included 9 girls. The winners came from 17 states; New York was the home of nine of the winners; of these, six came from New York city. South Carolina had a winner for the first time in 18 years; this brought the total number of states who have contributed winners to 44 since the program was started in 1942.

* * *

Rear Admiral Wilson D. Leggett, Jr. (USN-Ret.), Vice President of Engineering Services of Alco Products, Inc., spoke to a meeting of students members of the American Society of Mechanical Engineers on Feb. 18, 1959, and told them that one of their major responsibilities to the field of engineering was to encourage more young men to study engineering. Leggett said that the shortage of engineers was one of the most serious problems facing America today. He also stated that the future availability of trained professional engineers would greatly affect the country's standard of living.

* * *

Dean Mason has started a new idea in student-faculty relationship. Most of the graduating seniors have been invited or will be invited to an afternoon "tea" which is held on Thursday afternoon from 4:00 until 5:00. Such an informal session has long been lacking around the school and I'm sure that much good will come out of these discussions.

* * *

The Graduate Record Exam was held recently and the graduating seniors were all gathered into Government for a full day of testing. The Advanced Engineering exam was taken in the morning and the General Aptitude Test was taken in the afternoon after a one-hour break from the morning session. Toward the end of the exam many of the people taking the tests were getting pretty slap-happy; this seems to be a pretty poor arrangement for such important exams. It seems that somebody could arrange to have the exam given in two distinct parts and that the parts be given on different days. Then the exams might truly test a students knowledge instead of his ability to withstand fatigue! This represents a true case where thinking is done under stress. . . .

* * *

Commencement ceremonies will be held for the graduating seniors on June 3. Despite the fact that this is the high point in a students career at G.W., every student is limited in the number of people that he can invite to actually view the commencement ceremonies. It seems that some type of schedule could be arranged wherein the graduates could invite any and every one that they desired to. Perhaps some type of graduating ceremony could be aranged by school rather than by university in order to give more students an opportunity to invite their friends and relatives.

* * *

Electrical engineering is the most popular field in engineering with a total of 56,000 undergraduates; mechanical engineering is next with 44,000; civil engineering is third with a somewhat lower proportion of the engineering students.

* * *

In the graduate field electrical engineering is the most popular; chemical engineering is second and mechanical engineering is third.

* * *

Women accounted for less than 1% of the total enrollment in undergraduate curricula. In the fall of this year there were 1,396 women studying for degrees in engineering.

* * *

A recent mission sponsored by the American Society for Engineering Education and the National Science Foundation spent three weeks in Russia studying and inspecting technical education in that country. They found that high quality engineering was effectively integrated into the overall economy of Russia and that the engineer and scientist is held in particularly high esteem by other professions. Almost one-third of the total enrollment in the engineering schools of Russia are women and all competition is keen.

These are figures from a recent release of the American Society for Engineering Education: The beginning class in the 153 accredited engineering colleges was 59,164 this fall compared to 67,071 in the fall of 1957. This represents a decrease of 2.9%.

* * *

The number of engineering graduates, however, has not been affected yet. In fact, 31,216 graduated in 1957 as compared to 27,748 the previous year.

* * *

The total number of students in these accredited institutions has increased while the number of engineering students has decreased. Engineering students now comprise less than 7.7% of all students as compared to 8.5% in 1957. More important: the enrollment of second-year engineering students is down 6% from 1957 and third-year students are down 4%.

* * *

Graduate studies are now luring more students than in the past. Last spring 5,751 master's degrees were awarded and there were 653 doctor's degrees awarded. This fall 27,456 students were enrolled in programs leading to a master's degree and 4,762 were enrolled in programs leading to a doctor's degree. This represents gains of over 14% over the previous year.

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LETTERS TO THE EDITOR

Dear Sirs: Progress indeed—we were proud of the *Mecheleciv* in this clipping from the GWU student paper ten years ago. The current issues are a real pleasure to read. I thought you might find this article of interest, perhaps for publication.

JERROLD MICHAEL

QUOTE: For untold centuries, engineering has been synonymous with progress. In the School of Engineering at GWU, we can find progress in teaching, equipment, and research over a period of several years. In a similar line, the school paper, *"Mecheleciv"* (derived from Mechanical, Electrical, and Civil) has progressed from a one page mimeographed paper to a multi-paged printed magazine with a large paid subscription.

"Mecheleciv" contains news of students, alumni, engineering societies and fraternities, editorials, and feature articles written by students. The magazine, published under the direction of the Engineer's Council, has for its staff: Editor-in-Chief, Hollis K. Kushman; Business Manager, Keith Allen; Circulation Manager, Glen H. Ballowe; Copy Editor, Jerrold M. Michael; Alumni Editor, Claude C. Dimmette, Jr.; Photographer, Clinton Ward; Faculty Advisor, Frederick H. Kohloss.

This is the first year the *Mecheleciv* has been published on a self-supporting basis. Subscriptions were sold for one dolar to cover issues for one calendar year. Although the staff has encountered "growing pains" in the expansion of the publication, it is hoped the magazine will prove a definite asset to the school.

Thanks for the compliment and the article. The Mecheleciv is still encountering growing pains, and, I guess, always will. At any rate, we always appreciate comments from alumni and hope you will enjoy the future issues also. Incidentally, we are sending this clipping back to you. It was so yellow with age, we felt it might be a family heirloom. Thanks again. *EDITOR*

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THE EDITOR'S PAGE

Every so often a participant in student activities here at G.W. comes across a person who seems to be just the right one for a particular activity. This situation occurs very seldom but when it does, it stirs up the sometimes dormant feeling that student activities are really worthwhile.

This situation has occurred this past semester on the MECHELECIV *Magazine. As many of you know, the magazine staff has slowly deteriorated in the past two years until the Editor was in the position of having to put out the magazine with virtually little help in the way of good, sound, creative writing. Last year the magazine formulated a more liberal policy of accepting a few articles that were not of technical nature. The reprieve gained by this policy was short-lived; the magazine slowly dwindled from 50 pages in 1957 to 20 pages this past Fall. National advertising began to decrease noticeably during this period and the magazine was further subsidized by the Engineers' Council.*

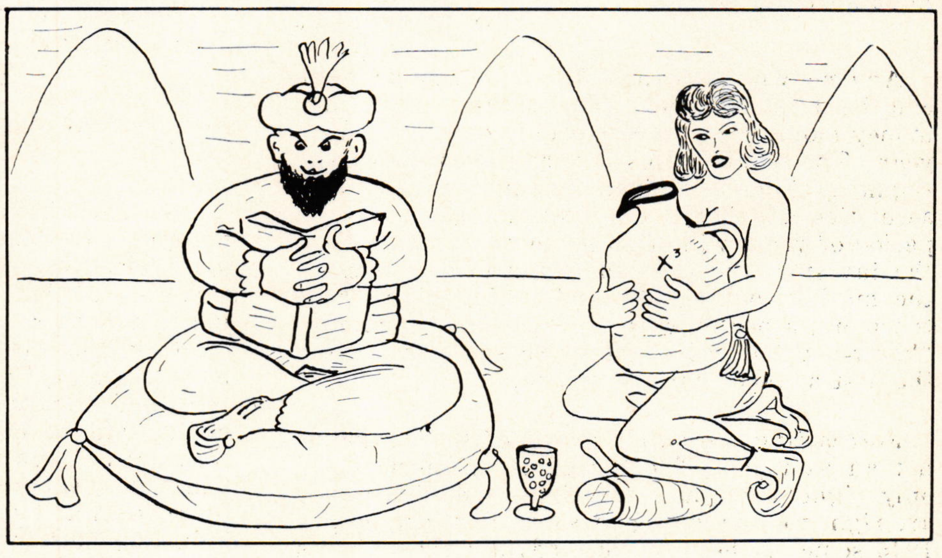
This downgrade halted abruptly this past February when a new policy was established for the magazine. It was decided that the MECHELECIV *would no longer cater to highly technical articles but would endeavor to print articles of interest to the engineering student body. At the same time, there was a high level reorganization on the Board of Editors and a concrete organizational chart was formulated. It was at this time that the publication of the magazine became a very important part of the school life of Bill Franklin. Since then, Bill has aggressively managed the magazine and has produced a good, readable periodical for the engineering student body as well as the alumni.*

The School of Engineering, the MECHELECIV, *and the Engineers' Council owes Bill a well-deserved "thank you" for his work as Associate Editor and Issue Editor.*

I would like to thank you, Bill, on behalf of the MECHELECIV *and the Engineers Council for your work and efforts in producing three fine issues of the* MECHELECIV *magazine.*

EDITOR

The Thinkers' Page



A SUMMARY OF AN EXECUTIVE'S JOB

As everyone knows, an executive has practically nothing to do, except to decide what is to be done; to tell somebody to do it; to listen to reasons why it should not be done, why it should be done by someone else, or why it should be done in a different way; to follow up to see if the thing has been done; to discover that it has been done incorrectly; to point out how it should have been done; to conclude that as long as it has been done, it may as well be left where it is; to wonder if it is not time to get rid of a person who cannot do a thing right; to reflect that he probably has a wife and a large family, and that certainly any successor would be just as bad, and maybe worse; to consider how much simpler and better the thing would have been done if one had done it oneself in the first place; to reflect sadly that one could have done it in twenty minutes, and, as things turned out, one has to spend two days to find out why it has taken three weeks for someone else to do it wrong.

— from *Personnel Management and Industrial Relations* by Dr. Dale Yoder

DOLLAR COST AVERAGING: THE ROAD TO RICHES?

by Bill Franklin

Past experience should be a guide post, not a hitching post.

—*D. W. Williams*

Anyone who can save $15 a month or more can be a stockholder. The secret: save your money monthly but invest it only once or twice a year. The point in this is that the investor who regularly invests a fixed amount in promising securities and keeps the program going over a period of years will often make more money than the investor who tries to forecast the moves of the market, buying low and selling high. Furthermore, a person with no experience or market "know-how" is more apt to be successful using the first method than the second.

Forecasting the major moves of the market is not an easy job. The big advisory services are only right about half the time; sometimes they are right for the wrong reasons. For instance, in 1946 some of these services advised their clients to sell on the theory that a bear market had begun. As it turned out, the market did decline a little, but it reversed itself and turned up for the greatest sustained rise in history. Thousands of dollars were spent in reaching this decision, and it turned out wrong. At the most, it was just an educated guess.

The method discussed in this article is sometimes known as *dollar cost averaging,* since it automatically averages out the cost of your shares. But before we go any further, one point should be made clear. To discuss dollar cost averaging as the ideal way to invest may seem like an about face after the article pointing out the advantages of mutual funds (Mutual Funds: Dollars and Sense, Mecheleciv, April, 1959). Actually, there is no ideal way to invest. If there was, certainly no person in his right mind would go around writing articles about it. However, there are ways of investing that are better than others, especially when different degrees of financial experience are involved. The object of these articles has been to point out a few facts about investing, facts which you may accept or disregard; no attempt has been made to advise anyone on the best way to invest, because this varies from person to person. Emphasis has been on investment programs that require very little financial experience, but these same approaches are used by many veteran investors.

With this in mind, let's point out some of the characteristics of this so-called dollar cost averaging.

As mentioned before, there are countless ways of investing. One way is to speculate, buying when you think stock prices are going up, and selling when you think they are on the way down. This is necessarily investing for the short term; it's tricky; it's dangerous, and sometimes disastrous. For this reason, let's eliminate speculation as a way of investing that we might be interested in.

Instead, let's invest for the long term; that is, design a program in which we will invest for a long period of time—maybe 25 or 30 years. In this way, all short term fluctuations in the market will not bother us as long as the general trend of stock prices is up. Our objective, then, should be to regularly invest our money in a particular stock and start an accumulation program. But we don't want to go on acquiring the same stock forever; as soon as a reasonable stake is established in one, we will stop investing in that stock to move on and start with another (in a different industry, perhaps). Remember, as long as the trend in stock prices is up, your stake in a company is appreciating even when you aren't adding to that investment. No one can expect to pick the one stock that will do the best, so we don't want to put all of our money in one security. Eventually, a person should try to spread his money among five or six stocks of good quality in five or six industries.

Suppose you decide to follow this plan and invest regularly. There are two ways this can be done: a fixed *amount of money* can be invested regularly in a stock regardless of the buying price; or, a fixed *number of shares* can be purchased regularly regardless of the amount of money it will require. The first method is called dollar cost averaging. One of the interesting aspects of this method is that you automatically buy more shares of a stock when the price is down and less shares when the price is up. Using the second method, one will be buying a fixed number of shares regularly, but he will be paying more, naturally, when prices are up and less when prices are down. Which method is the best? The following example can be used to answer this question.

Let's assume there are two investors: X and Y. Mr. X decides he will use dollar cost averaging in his investment program, whereas, Mr. Y decides he will use the second method described above. The important thing to remember is that they both have the same amount of money to start with, $1,000. They are both investing in the same stock, at the same time, for the same length of time. The difference is in the methods they are using to employ their money. Referring to the table, we can see how they came out.

date	*Y's Program* assumed price per share	number of shares bought	cumulative total cost	cumulative cost per share	*X's Program* number of shares bought	cumulative total cost	cumulative cost per share
12/31/52	100	10	$1,000	$100.00	10.0	$1,000	$100.00
12/31/53	75	10	1,750	87.50	13.3	2,000	86.00
12/31/54	50	10	2,250	75.00	20.0	3,000	69.30
12/31/55	25	10	2,500	62.50	40.0	4,000	48.00
12/31/56	75	10	3,250	65.00	13.3	5,000	51.80
12/31/57	125	10	4,500	75.00	8.0	6,000	57.40
12/31/58	150	10	6,000	85.80	6.7	7,000	62.90
12/31/59	200	10	8,000	100.00	5.0	8,000	68.75
Totals		80	$8,000	$100.00	116.3	$8,000	$ 68.75

Note that both men spent $8,000 during the eight year period. Investor X, however, put a fixed number of dollars into stock regularly and ends up with 116.3 shares costing an average of $68.75. Investor Y, on the other hand, bought a fixed number of shares regularly and ends up with 80 shares costing an average of $100.00. This example is not rigged. Make up one of your one, using any assumed stock prices, and you will find in every example the man using dollar cost averaging will come out ahead; that is, he will end up getting his stock cheaper. There is one exception. If the stock declines and keeps on declining, the investor who buys a fixed number of shares will lose less money. The selection of a well-managed company in a growing field, therefore, is an essential part of an investment program. No method of purchasing will succeed if the stock fails to qualify.

One other point before we go on—you cannot buy fractional shares of stock. Hence, in the example, there are a few negligible errors. For example, at the end of 1953, you could have only bought 13 shares instead of 13.3; the money remaining could then be used to apply against stock the following year. This fact would have to be taken into account to make the table a true example; if you do this, however, the changes are trivial.

For a final example, the results of a hypothetical investment of $1,000 a year based on the Dow-Jones Industrial Stock Average is shown in the following table. All dividends were reinvested the following year, but no allowance was made for brokerage commissions.

year	total amount invested (cumulative)	shares owned at end of period	value at end of period
1946	$1,000	5	$1,000
1947	2,040	11	1,972
1948	3,144	17	3,124
1949	4,344	24	4,355
1950	5,652	30	6,507
1951	7,138	36	9,243
1952	8,724	42	11,421
1953	10,396	48	13,085
1954	12,137	53	18,069
1955	14,060	57	25,071
1956	16,294	62	31,778

Courtesy of Merrill Lynch, Pierce, Fenner and Smith

From these two tables, you should see the advantage in investing for the long term. Notice that in 1947 and 1948 the investment lost money, but this was a short term fluctuation; in the long run, it averaged out to an appreciated value nearly twice the amount of the investment. There is no reason to believe this boom will not continue. It is true that between 1956 and the present time, a recession occurred, but pick up a Wall Street Journal someday and look at the Dow-Jones Average (average of 30 industrial stocks, 20 railroads, 15 utilities). That should give you a general idea of the condition of the national economy.

Here are a few predictions for certain stocks in the next 25 years: engineering firms—up 200 percent, electrical machines—up 110 percent, and medical supplies—up 90 percent. Other industries that appear promising: automatic controls, electronics, chemicals, office and calculating machinery, paper, glass, oils, petrochemicals, drugs, light metals, road building equipment, and utilities in fast growing areas. Keep your eye on electronics, electrical, oil, and chemical companies involved in atomic energy.

Other predications state that in the next 25 years, the standard of living will increase, incomes will double, prices will generally rise 50 percent, the work week will be cut to four days, the rate of home building will double, and suburbs will move twice as far out.

This, then, is the future you have to look forward to after graduation. In general, the economy will be booming; you may as well take part in it. Once you get settled in your job, allowance should be made to put away a certain amount of money for investing, whether in mutual funds or in corporate securities using the method outlined in this article, or any other method or investment you choose. The important thing is invest in order to save your dollar from the shrinkage caused by inflation.

The advantage of using the dollar cost averaging approach is that less financial experience is required in order to be reasonably sucessful. Also, it takes the guesswork out of timing and gives you your stock at a reasonable price.

Invest $300 a year in a good growth stock, and in 25 years you should have many thousands of dollars; invest $1,000 a year, and should end up with a small fortune; invest more than that and . . . who knows? Maybe you'll quit engineering and play the market full time.

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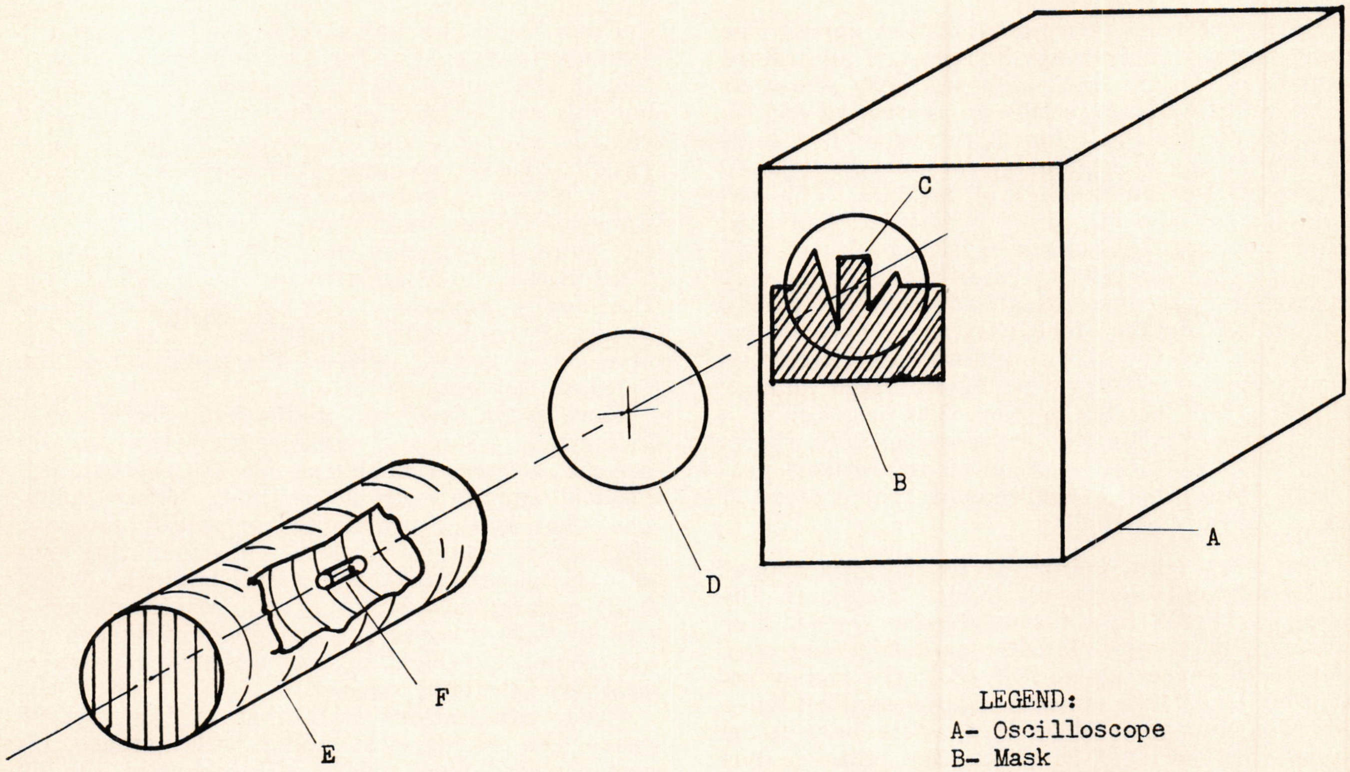
A FUNCTION GENERATOR

by Ray Howland



LEGEND:
A- Oscilloscope
B- Mask
C- Waveform
D- Lens
E- Photocell Enclosure
F- Photocell

The economical production of good, reliable function generators is a problem on which the electrical industry spends a great deal of time. Specific voltage or current functions are used through necessity throughout industry and home. Some of these uses require a very reliable and exact function. Several examples of a specific function being incorporated in a larger component are electronic switches, oscilloscopes, television, etc.

As is the case in most complex problems, there are many useful solutions; this is also true for the function generator. The particular function generator to be discussed here is one using feedback between a cathode-ray tube (CRT) and a photocell. It will be shown that this function generator is capable of producing any periodic, single-valued function at any frequency in a wide frequency range.

The most readily accessible and useful means of obtaining the CRT is to use a good oscilloscope. The CRT should be a short persistence, high intensity type. The photocell to be used must be a vacuum tube or a photomultiplier. Gas phototubes cannot be used because continuous operation is required, not an "on-off" operation characteristic. The photocell circuit is made by using a dry cell battery, resistor, and a photocell all in series. The output is taken across the resistor.

From these components, the function generator operates in the following manner. The function to be produced is cut out on a piece of opaque paper and placed on the face of the CRT such that the portion of the CRT face below the function is masked, and, hence, all of the tube face above the function is clear. The photocell is placed in front of the CRT, with the output of the photocell circuit going to the vertical input terminals of the oscilloscope. Now with the

proper bias level on the vertical plates of the CRT, the dot on the screen will be deflected downward if the light from the dot causes a current to flow in the photocell circuit. However, when the dot goes into the masked region of the CRT, the photocell sees no light and hence the photocell circuit has no output; thus, the dot comes back up to its original bias level and the process starts again. The only place the dot can come to rest is the point just between the masked and unmasked portion of the CRT; this is the value of the desired function. If at the same time this is taking place, the dot is swept across the face of the tube by means of the horizontal sweep circuit of the oscilloscope, the dot will follow the desired function. So it is seen, that, as the dot of the CRT is deflected up and down by the feedback loop of the CRT and the photocell, and swept across the face of the tube by the horizontal sweep of the oscilloscope, the function is generated.

If another oscilloscope is connected to the output of the photocell circuit, in order to observe its waveform, the observed photocell voltage waveform is the desired function that was placed on the CRT. Thus the desired output has been obtained and can be used as required.

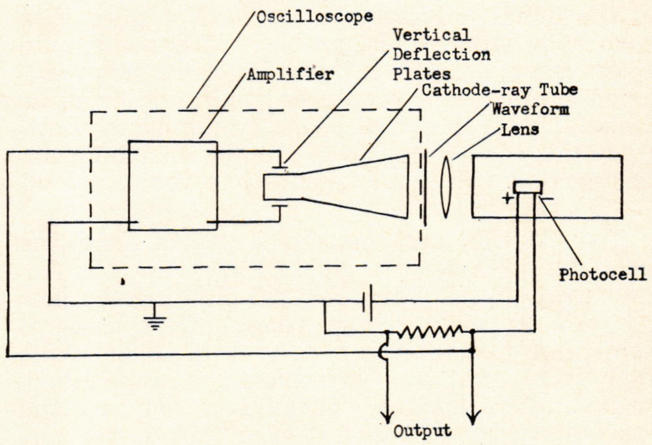
In the use of this function generator there are still many things we need to know about the function, such as its frequency, time response, how clean or free of noise the output is, etc. We also need to investigate means by which the general system may be dressed up to produce a better, more nearly exact reproduction of the desired waveform.

First, what can be done to dress up the system? We know that signal levels of this type system are in the millivolt and microampere region. All the electrical connections must be shielded to eliminate "pick-up". Furthermore, the photocell and CRT must be enclosed in a black box so that no outside light gets in to the system to give rise to an extraneous signal. The photocell should be as close as possible to the CRT so that the light intensity of the CRT dot will be strong enough for the photocell to "see" it. Remember, the light intensity of the dot falls off as the square of the distance. Thus, if the CRT and photocell are too close, the photocell will "see" more light in the center of the screen and less at the edges. But if a double convex lens is placed between the CRT and photocell, and if the photocell is placed near the focal length of the lens, the photocell will "see" a nearly constant amount of light regardless of where the dot is on the face of the CRT. The lens used must have a diameter slightly greater than the diameter of the face of the CRT so that the entire face may be covered. Even though there is a constant light intensity, the distance between the CRT and the photocell must be as short as possible so that this constant value of the light intensity will be high enough for the photocell to "see" it. The spectrum response of the CRT and the photocell must be matched as closely as possible, again, so the photocell can "see" the dot.

Since the paper or cardboard used to mask the screen has some thickness, another problem that the use of the lens eliminates is parallax caused by the thickness of the masking material.

With the above sources of trouble removed, let us see just what the characteristics of the system are. The period of the function is the width of the screen; hence, by varying the sweep of the oscilloscope, the frequency of the output waveform is varied. Waveforms with vertical rises in them have been obtained to as high as 100 kc. with no measurable distortion on an observing oscilloscope. The persistence of the dot as it traces out the function is effectively the time constant of the system.

Another interesting fact about the system is that, for a given sweep rate, the vertical gain cannot exceed a certain value before the system breaks down and becomes unstable. If the gain is too high, the dot will be "kicked" so hard by the photocell, that it becomes lost on the face of the scope and it will not be able to follow the desired waveform. If the sweep rate is decreased and the gain held constant at some lower sweep rate, the system will again become stable.



Schematic Diagram of Function Generator

As is to be expected, if the gain causes instability at some high rate of sweep, the system won't be able to follow the given waveform, and the peaks of the function will become rounded off. By using a good oscilloscope, this breakdown frequency is greater than 100kc. for a square wave. The square wave is the limiting waveform, since a Fourier analysis of it reveals the square wave is composed of an infinite number of sinusoidal waveforms.

The ease with which this generator can be constructed is surprising; yet, it is capable of reproducing any single-valued waveform that can be drawn. Also, the noise level of the reproduced waveform is such that it can be amplified and used as needed. These features make the type of function generator described in this article a very useful tool; it's well worth remembering.

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THE FINANCING OF A NEW HOME

by Woody Everett

As the end of their college career approaches, many engineering students look forward to the days when they will be making attractive salaries and perhaps become interested in various types of investing. Many of the students will settle on a home for their first major investment as have Americans for many, many years. It is the American way to look forward to owning your own home and planning for future years around it. It is also the American way to buy such large and expensive items as a home on credit because, frankly, few people have the available cash to buy a home outright. So, you may find yourself in the position, one of these days, of having found the "perfect" home but of only having a portion of the money necessary to buy it. You must then turn your mind to the problem of financing. In most cases, especially those involving high salaried professional people as engineers, it is no trouble at all to obtain adequate financing; however, there is quite a lot of trouble in finding financing that will be the cheapest to you.

Two of the most popular types of financing available to American citizens are Veterans Administration (GI) and Federal Housing Authority (FHA) loans. Most people think there is something magic about these two types of loans; they think that you just make an application, wait a few weeks, then move into your house and start monthly payments. This is not a true picture. Let's look into this matter of GI and FHA loans.

First of all, in order to qualify for a new GI loan, an American citizen must have been in the armed services, discharged honorably, and never used his privilege of a GI loan before; i.e., a person may obtain a new GI loan only once in his lifetime.

Now, upon qualification for the loan, you must make application on a particular house. GI inspectors go out and look at it and appraise the house and lot. Suppose they decide that the house and lot are worth $15,000. An inspection is made of your personal affairs by the Veterans Administration to determine if you can actually afford to buy a home and make the necessary monthly payments. If, after this careful inspection, the Veterans Administration thinks you are capable of carrying the loan, they will tell a commercial money-lender (a savings bank, an industrial bank, or maybe a home loan establishment, or a big insurance company) that they will guarantee a loan of $15,000 on this property. The Veterans Administration also sets a definite amount of interest, say 5%, that the money-lender may charge you for the loan and establishes a definite period for the loan to cover, i.e. 20 years, 25 years, or 30 years.

The money-lender may tell you that he will loan you the money to buy the house at 5% interest; however, when he can get a higher rate of return on his money at this time, he will charge you a discount ranging from 1% to 9%. This means that he will charge you from 1% to 9% of the amount of your loan before he will loan you the money at 5% interest. Assuming the maximum rate of 9% is charged on your $15,000 home, you will have to pay the money-lender $1350 cash as a discount. Also, you must set up a tax and insurance account with the money-lender and make additions to it each month. This account is called an *escrow,* and from it, money is taken out to pay the yearly taxes on the property and the casualty insurance. You make additions to this escrow account, in your monthly payments, insuring the money-lender that there is, at all times, enough money set aside to pay a full year's taxes and insurance on the property. A full year's taxes and insurance might amount to $240 or $20 per month. Therefore, in addition to your discount, you must pay the money-lender $240 in cash to establish the escrow. Now, if the total cost of your house was $15,000, you can move into your house and start your monthly payments. However, if the owner of the house wants $15,800 to sell it, you would have an additional $800 to pay because your loan will only cover $15,000 of the buying price. That is, you must make an $800 down payment.

When you are buying property, you will want to assure yourself that you are getting a title free of any prior liens; therefore, you should retain an attorney to make a title search of all land records to see that you have a clear title. This will cost approximately $100. Therefore, to purchase your home for $15,800, you have paid in cash a $1350 discount, a $800 down payment, a $240 escrow bill, a $100 attorney's fee (total $2490), and you still owe a mortgage or trust note of $15,000. To carry this further, you will now have monthly payments of $20 for the escrow account and a principal and interest payment of $99.00 (assuming the loan was payable in 20 years) for a total of $119.00 per month.

On the other hand, suppose you had decided to obtain an FHA loan instead of a GI loan. You would have made application to the Federal Housing Authority on similar forms as those of the Veterans Administration. The FHA inspector would then appraise the house—say again for $15,000. After making a thorough search into your private affairs, they would determine that you were capable of carrying such a loan. Now the difference between the two types of loans appears. The Veterans Administration gave you a loan in the full amount of their appraisal; however, the FHA will only give you a loan in the amount of approximately 90% of the appraisal value. Therefore, they might agree to underwrite or guarantee a loan of $13,500 (90% of $15,000) for you on the particular house. The FHA will tell a commercial money-lender that they will guarantee a loan of $13,500 for you to be paid back in 20 years at the rate of 5¼ interest. However, before the FHA will guarantee a loan you must agree to pay them an insurance rate of ½% of the loan per year. For an FHA loan you must actually pay interest at the rate of 5¼% plus ½%. The money-lender will tell you that he will lend you the money for the house, but again you must pay him a discount of say, 2% or $270 cash. Again, you must set up the tax and insurance escrow account at the cost of $240, and you must pay an attorney for the title search, another $100. Since your loan was in the amount of $13,500, and your house costs $15,800, you must pay the difference of $2300 as a down payment. Therefore, to purchase your home for $15,800, you must pay in cash a discount of $270, a $2300 down payment, a $240 escrow bill, a $100 attorney's fee (total $2910), and you still owe a mortgage of $13,500. Your monthly payments will be $20 toward the tax and insurance escrow, and a principal and interest payment of $105.32 for a total of $125.32 per month.

This covers the procedure followed in the common FHA and GI loans. These two types of loans are more popular today than any other because they allow the home-buyer to purchase a home for a low down payment. The discount rates of money-lenders vary with the amount of inflation across the country. In 1950 money-lenders would lend money at rates above 4% without discounting; now money-lenders will only lend money without discounting at rates above 6%.

Another type of loan that is fairly common today is the so-called "conventional" loan made by the savings and industrial banks, savings and loan associations, and independent loan companies. The big drawback about these loans is that you can only borrow up to approximately 60% on the value of the property. This necessitates a large down payment of 40% or more. In the case of the $15,000 house one would have to make a down payment of $6000. Few people have this much money available in ready cash, and therefore, are forced to seek other means of raising the necessary down payments.

A particular type of financing that is peculiar to this area of the country is assuming the present loan and giving the owner of the house a second trust. This type of financing is more complicated than those previously mentioned but affords a savings in many cases to the prospective home-buyer. Again, take the case of the $15,000 house. (Bear in mind that this type of financing must be designed to fit only a particular case, and a general procedure cannot be outlined that would apply to all cases.)

Suppose the person who owned the house was willing to let you first assume his old loan and he would take a second trust note on the property. For a hypothetical case we could take a situation that exists in the financing of many of the houses in surburban Virginia. The person who owns the house may have purchased it 5 years ago and at that time obtained a loan, either FHA or GI, to be paid back in 20 years and at the rate of 4½% interest. They still owe $12,500 on this mortgage which is a first trust note because there are no other loans on the property that have prior claim to it in case of default. The houseowner tells you that he will sell you the property for $15,800, let you assume his first trust for the amount he owes on it, and he will give you a second trust (so-called because there is one note on the property that has a prior claim to the property in case of default) note for $3000, the amount he has already paid on the loan. The interest on most second trusts is at a rate of 6% and payable in monthly installments. For this example, assume the home-owner requires that you make payments on the second trust of $25 a month with the full amount of the note due and payable in five years. This means that you will pay him back $25 per month, principal and interest for a five year period, and at the end of the five year period you will pay him the full balance of principal remaining. With such an arrangement you have a down payment of $300, an attorney's fee of $100, a loan assumption of $25 (this covers the cost of having your name substituted as the, "payer" of the original first trust), and a tax and insurance escrow bill of $240. This means you could buy your house at a cost of $15,800 for $665 cash and that you now have a first trust of $12,500 at 4½% and a second trust of $3000 at 6%.

As you can see, the advantage of this method of financing is that you can actually buy your own house at a very low down payment. One big disadvantage is that the cost of your monthly payment is high because you have to make the normal payment on the first trust every month plus the additional $25 per month on the second trust. Again, this type of financing must be fitted to each individual case and no general rule can be found that will cover every situation.

You, as a prospective homeowner, can now see the difference in the many types of available home financing. You must, for your own interest, consider carefully before you decide upon the manner in which you finance your "dream" house.

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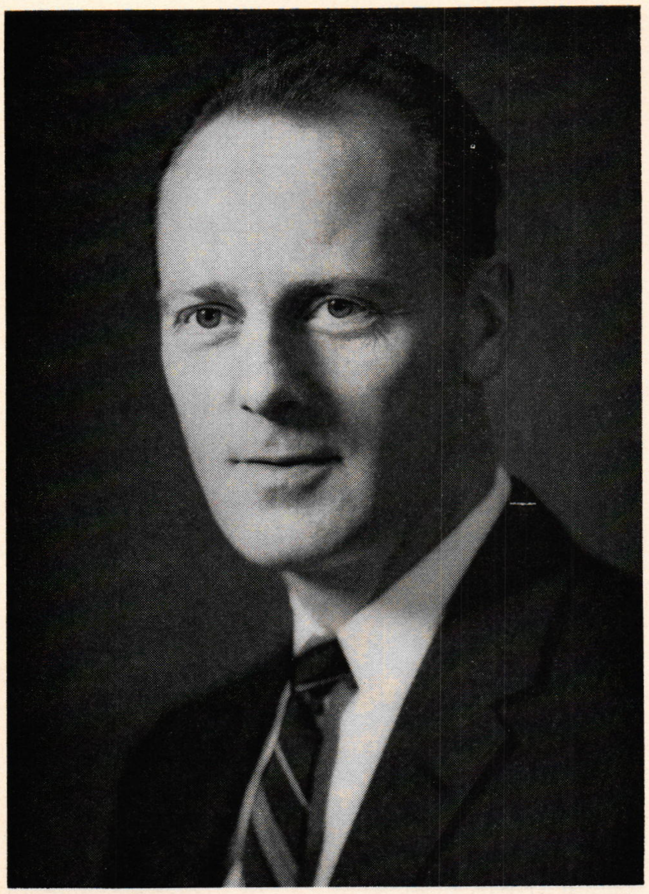


Earl S. Williams

Earl S. Williams, a 1957 graduate of American University, is a physicist with the Electrical Instruments Section of the National Bureau of Standards. The Section makes measurements of electrical current, voltage, power, and energy, and the dielectric strength of materials. Mr. Williams assists in the development of instruments and techniques for measuring current and voltage at audio frequencies. These are used to calibrate reference and working standard instruments sent to the Bureau for certification.

Born in Cantoa, North Carolina, in 1920, Mr. Williams attended Mars Hill College and the University of Richmond, and received his B. A. in physics from American University in 1957.

Mr. and Mrs. Williams now live with their two sons, Douglas and Eric, at 5020 Bradley Boulevard, Chevy Chase, Maryland.

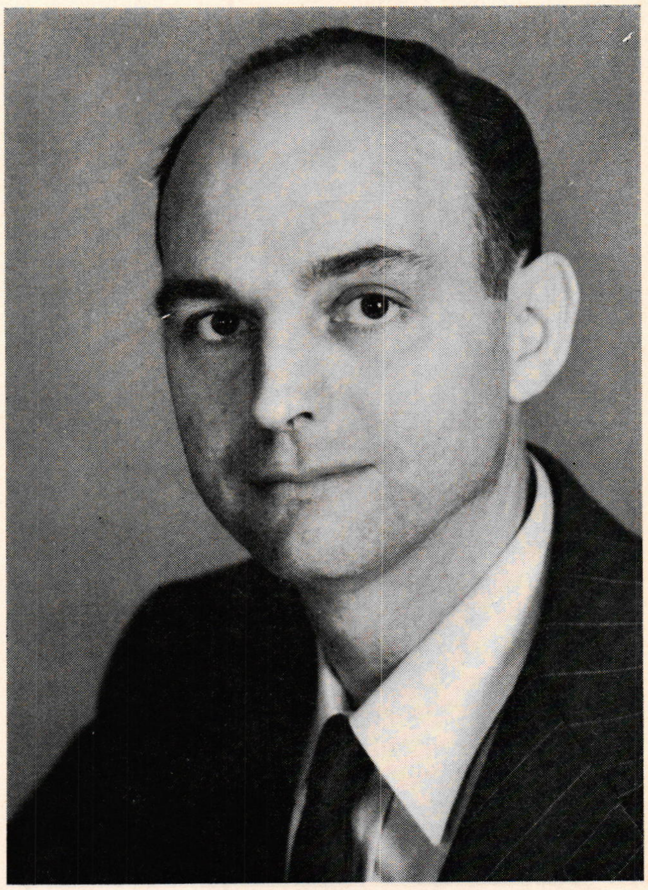
Mr. Francis L. Hermach, a 1943 alumnus of The George Washington University, is employed at the National Bureau of Standards as an electrical engineer. Mr. Hermach is in the Electrical Instruments Section of the Electricity and Electronics Division.

Here, he is concerned with the development of instruments and other apparatus for calibrating ammeters, voltmeters, and wattmeters with high accuracy at power and audio frequencies. Another of his duties is the development of methods for evaluating equipment, such as conductive floors and "anti-static agents", used to mitigate fire and explosion hazards from static electricity.

Born in Bridgeport, Connecticut, in 1917, Mr. Hermach came to the Bureau in 1939. He received a Bachelor of Electrical Engineering in 1943 from The George Washington University. He has also received the U. S. Department of Commerce Silver Medal for Meritorious Service, and the National Bureau of Standards award for Superior Performance in 1954.

Mr. Hermach has written numerous technical Papers in his field, and is a member of the American Institute of Electrical Engineers, the Instrument Society of America, and the Institute of Radio Engineers. He is also responsible for a patent on a Volt-Ampere Converter.

Mr. and Mrs. Hermach and their two boys now live in Silver Spring, Maryland.



Francis L. Hermach

AUDIO-FREQUENCY VOLT-AMMETER

Accurate voltage and current measurements are now possible over a frequency range from 5 to 50,000 cps with a self-contained, portable volt-ampere converter recently developed at the National Bureau of Standards. The increasing use of audio frequencies, especially in airborne devices, has made necessary the development of special equipment and transfer standards for tests of instruments operating in this range. As the primary electrical units are maintained by d-c standards, all a-c measurements of voltage, current, and power are actually based on transfer instruments, which are standardized on direct current and then used on alternating current.

Based on an earlier and more limited prototype, the present instrument was designed and constructed by *F. L. Hermach* and *E. S. Williams* of the Bureau's electrical instruments laboratory for the NBS Electronic Calibration Center at Boulder, Colorado. Among other changes, 12 voltage ranges from 0.5 to 600 v and 11 current ranges between 7.5 and 20 amps are now available. These ranges may be used either for d-c or a-c measurements with a 1.5 v potentiometer or for ac-dc transfer tests of instruments.

Like other transfer instruments for accurate standardization at the higher audio frequencies, the improved volt-ammeter utilizes a thermal converter as the sensitive component. A thermal converter consists essentially of a conductor, heated by the alternating current to be measured, and a thermocouple, thermally attached near the center of the heater. The heater of the converter is connected in series with appropriate resistors for voltage measurements and in parallel with appropriate shunts for current measurements. The output electromotive force produced in the thermocouple is first balanced against the voltage from an internal d-c "bucking circuit" to obtain a null reading on a built-in galvanometer. Then the heater is switched to an internal d-c circuit, which is adjusted to give the same output emf and therefore equivalent heater current and voltage drop. A simple multiplication of the voltage measured across a portion of this d-c circuit yields the unknown alternating voltage or current. The 7.5 ma thermal converter used has excellent transfer characteristics, its ac-dc difference being less than 0.01 percent at audio frequencies.

Changes in heater resistance are compensated by connecting additional resistors in the circuit. In voltage measurements, a resistor equal to the series resistance is placed in parallel with the thermal converter in the d-c position. In current measurements, a resistor equal to the shunt resistance is placed in series with the thermal converter in the d-c position. The accuracy of the instrument is then dependent only on the potentiometer used to measure the voltage and on the highly stable internal resistors.

A function selector switch is used to connect the thermal converter circuit to the shunts for alternating current measurements and to the series resistors for alternating voltage measurements. For direct voltage measurements, the 1.5 v section of the series resistors is connected directly to the potentiometer, and for direct current measurements the shunt voltage is connected directly to the potentiometer. This relatively simple switching permits the same resistors and shunts to be used for d-c as well as a-c measurements, thus greatly increasing the usefulness of the instrument.

Binding posts on the panel make possible the inclusion of a milliammeter in the balancing circuit to measure the thermal converter output voltage. With these data and a converter characteristic curve, ac-dc difference tests can be made of voltmeters and ammeters with an accuracy of 0.02 percent In such tests the volt-ampere converter is connected in series with the test ammeter, or in parallel with the test voltmeter. Alternating and direct current are then applied successively to the arrangements. By using a more sensitive external galvanometer in place of the built-in galvanometer, the ac-dc difference of the test instrument can be obtained.

Special precautions were taken to minimize reactance. High-quality resistance cards were used for the series and shunt resistors of 1 ohm or more. Shunts of lower resistance, for the higher current ranges, were constructed of bifilar strips of Ni-Cr-Al-Fe alloy with insulation of 1-mil polyester film. In addition, rotary switches with enclosed silver contacts were used to give minimum contact resistance, inductance, and internal capacitance.

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EDUCATION: A MEANS OR AN END?

by Bob Moore

For nearly two hundred years, ever since the United States was established, Americans have gone forward secure in the belief that the American way of doing anything was automatically the best way. But then, a little more than a year ago, at a time when the United States was at its peak in world prestige and power, the American people were shocked by Russia's launching of the first Sputnik. Immediately a hue and cry was raised that the United States must reappraise its educational system, must pay more money to its educators, that in effect, we must, in the greatest American tradition, mass produce the educated people that we need, particularly engineers and scientists.

The basic idea presented with this outcry that more Americans should be educated can not be objected to by any thinking individual. What can be objected to is the reason that has been given for its motivation. Until Russia launched its Sputnik, the vast majority of Americans were well satisfied with our educational system. Of course, there was a small minority of educators who felt that our system was lacking, but they were only "voices crying in the wilderness". When Sputnik blazed across the sky, these voices were no longer crying unheard, but they may as well have been, for then they were drowned out by the chaos which resulted.

But what was the reason for this great outcry? It was the fact that Russia had shown the intention of overcoming our ability to out-produce any country in the material things of life and that Russia's method in accomplishing this scheme was by emphasizing the education of engineers and scientists. In other words, Russia was using higher education as the means to obtain world power and prestige, as a means to an end.

But is this the real purpose of education? Is this the only reason for which man has accumulated knowledge through the ages? Is it the only reason that man was given the ability to think and reason logically? None of the great thinkers of the ages thought so. Aristotle gave the world many theories of science, and for centuries his thinking dominated all scientific thinking. But then many of his ideas were proven to be wrong. Plato wrote of man's purpose, but modern philosophers do not agree with all his ideas. But the great contribution of these two men to Mankind, and the contribution of any man who thinks, is not the accuracy of their ideas, but the fact that they thought and that the ideas and concepts that they produced caused other men to think. This is the magic word—*thought,* for when man ceases to think, he ceases to be a man and becomes instead merely another of the numberless animals who do not live but only exist.

The idea that the United States must reappraise its educational system, that we must give more money to our educators, and that we must educate more Americans can not be disputed, but we have to go further than this! We must appraise not only the methods of our educational system, but also reappraise the purpose. We must realize that the material comforts of life are only the by-products of learning and education.

If the United States is to make any lasting contribution to Mankind, and if we are going to retain our position as leader of the free people of the world in the fight against tyranny, we must recognize the most basic purpose of education: it is not to enable man to accumulate a great storehouse of cold inanimate facts, but rather to teach man to think. By thinking, man rises above his material surrounding and becomes an individual unto himself—a distinction which is enjoyed by no other creature.

By education, man can accomplish this greatest of all purposes and can realize that education is not a means to an end but is an end unto itself—perhaps the greatest end that man has ever accomplished!

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DIANA

The attractive young lady appearing on these pages is Diana Merediz. While her father is attached to the Embassy of Argentina as a representative of the Steel Society of Argentina, she is attending G.W. as an accounting major.

Diana was born 19 years ago in Buenos Aires and lived all but the last three years there. When her family moved up here in April, 1956, she couldn't speak a word of English. Aside from adjusting to the language and the customs of this country, however, Diana also had to get used to the seasons of the year. When it is summer in the United States, it is winter in Argentina, and when it is autumn here, it is springtime there. Hence, Christmas (celebrated on December 25 also) is one of the hottest days of the year, and July 4 is sometimes their coldest.

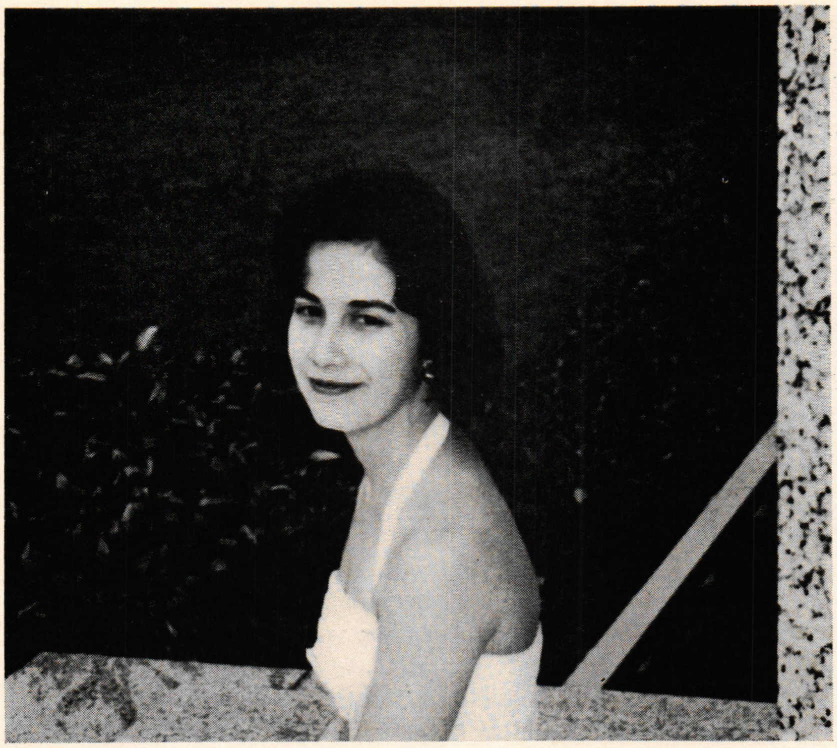
Although there's no place like home, Diana likes the United States very much. She has travelled quite a lot in the eastern part of the country, but would like to go out West this summer. This suggestion brings rousing cheers from her brother, Tristán Octavio, 13 years old, whose first love is the television horse opera. He can recite at length (in a Western drawl) the number of men Wyatt Earp shot last week, the poker hand that saved Maverick from hanging, and the name of the dirty little coward that shot Jesse James in the back.

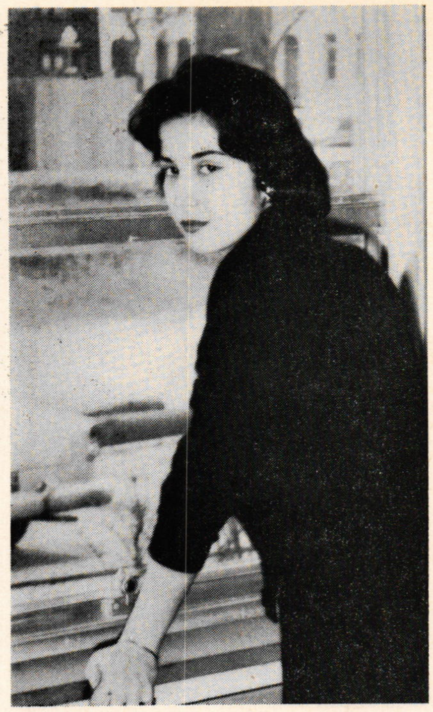
Diana's interests include "putterin' around the house," reading, and classical music, although she knows more about American history than most Americans. Incidentally, she and her family have seen some of her country's history in the making. In 1955 they watched the Peron revolution from their apartment window, including the bombing of the Dictator's residence several blocks away.

Comparing the United States with Argentina, Diana thinks the girls in this country are very independent and enjoy much more social freedom than they do in her country. And for both social and economic reasons, young people in Argentina do not date in cars. As a matter of fact, people don't "single-date" until they are 19 or 20 years old. She also noted that marriages in this country occur at a much younger age than they do in Argentina; there a man usually marries when he is in his late 20's.

Without further adieu, let's look at the pictures, men!

Photographs by Jack Bradley





HISTORICAL NOTES . . .

By Bill Franklin

AND SO THE END

The McLean house sat back from the road behind a sagging fence and a tired old gate. From the front lawn, nine wooden steps led up to a porch running the full length of the building.

It was a beautiful day—the sun was out, the weather warm. Off in the distance, a Caty-did hummed loudly. This was April, to be exact, April 9.

Several groups of men had congregated around the area; some were talking softly, others were just looking out at the rolling country-side. And a peaceful country-side it was too, certainly nothing like it had been for the past few days. For this and the surrounding area was known as Appomattox.

General Robert E. Lee waited inside the McLean house for the arrival of the Union commander, General Ulysses S. Grant. The two men were to negotiate surrender terms for Lee's Army of Northern Virginia; it culminated six days of hopeless, bitter fighting.

1:30 P.M. . . . Grant turned into the yard. He could have passed as any ordinary private of cavalry, except for the shoulder straps of a lieutenant general. He later wrote:

"When I had left camp that morning, I had not expected so soon the result that was then taking place, and consequently was in rough garb. I was without sword, as I usually was when on horseback in the field, and wore a soldier's blouse for a coat, with the shoulder straps of my rank to indicate to the army who I was."

Grant entered the house and greeted Lee. The two talked for a few minutes about the Mexican War, in which both had served. As they talked, several Union officers filed in and quietly arranged themselves around the sides of the room.

Lee: "I suppose, General Grant, that the object of our meeting is fully understood. I asked to see you to ascertain upon what terms you would receive the surrender of my army."

Grant: "The terms I propose are those stated substantially in my letter to you of yesterday—that is, the officers and men surrendered to be paroled and disqualified from taking up arms again until properly exchanged, and all arms, ammunition, and supplies to be delivered up as captured property."

Lee commented those were the terms he expected.

As the two men talked, several of the Union officers around the room were fascinated by Lee's dress and composure. The Confederate general was dressed in a new uniform, boots shined, and a beautiful sword at his side, a gift from the state of Virginia. And he was a gentleman—well-mannered, disciplined . . . a thoroughbred among men.

One of Grant's aides brought him a marble-topped table to write on after the two leaders had finished talking. The Union commander took out his order book and pencil and began to write the surrender terms. As he neared the end, he looked up, and seeing Lee's glittering dress sword, wrote a sentence: "This will not embrace the side arms of officers, nor their private horses and baggage."

When he stopped writing, Grant called his adjutant over to the table and told him to copy what he had written. The aide complained that he was too nervous, so another person was summoned. The Federal commander looked it over with him, underlining several words and striking out the word "their" which had been repeated.

Then the book was handed to Lee with the request that he read it to see if he would be satisfied with the terms. The terms read:

> General R. E. Lee, Commanding C.S.A.
> Appomattox Ct. H., Va., April 9, 1865
>
> General: In accordance with my letter to you of the 8th inst., I propose to receive the surrender of the Army of Northern Virginia on the following terms, to wit: Rolls of all the officers and men to be made in duplicate, one copy to be given to an officer designated by me, the other to be retained by such officer or officers as you may designate. The officers to give their individual paroles not to take arms against the Government of the United States until properly, and each company of regimental commander to sign a like parole for the men of their commands. The arms, artillery, and public property to be parked, and stacked, and turned over to the officers appointed by me to receive them. This will not embrace the side arms of officers, nor their private horses or baggage. This done, each officer and man will be allowed to return to his home, not to be disturbed by the United States authorities so long as they observe their paroles, and the laws in force where they may reside. Very respectfully,
>
> U. S. Grant, Lieutenant-General

After Lee had read the first two pages he commented that it appeared that the word "exchanged" was intended after "until properly", and asked if it was agreeable to mark where it should have been inserted. Grant consented.

As Lee read the section allowing officers to keep their arms, horses and baggage, he appeared to be touched by Grant's generosity.

"This will have a very happy effect on my army," the Confederate said.

Grant replied, "Unless you have some suggestions to make in regard to the form, I will have a copy made in ink and sign it."

For a moment, Lee hesitated. "There is one thing I would like to mention. The cavalrymen and artillerymen in our army own their own horses. Our organization differs from yours. I would like to understand whether these men would be permitted to retain their horses."

"You will find the terms as written do not allow it," the Union commander said. "Only officers are allowed to take their private property."

"No," Lee answered, "I see the terms do not allow it. That is clear."

But the expression on Lee's face showed he was anxious to have this concession made.

Grant seemed embarrassed to have the Confederate make this request: "Well, the subject is quite new to me. Of course I did not know that any private soldiers owned their animals, but I think this will be the last battle of the war—I sincerely hope so—and . . . I take it that most of the men in the ranks are small farmers, and it is doubtful whether they will be able to put in a crop and carry themselves and their families through next winter without horses.

"I will arrange it this way: I will not change the terms as they are written, but I will instruct the officers to let all the men who claim to own a horse or mule take the animals home with them to work their little farms."

"This will have the best possible effect upon my men," Lee said.

The book was handed to Grant and an ink copy made.

Charles Marshall, one of Lee's aides, wrote out an acceptance of the terms, but was forced to change the wording when the General told him: "Don't say, 'I have the honor.' He is here. Just say, 'I accept the terms.' "

Marshall had to borrow a few sheets of paper from the Federals to make the second copy, for he found his supply gone.

Quiet conversations now began in the room. Grant introduced his officers to Lee.

The Confederates mingled with the Federals and talked for a while. Then Grant asked how many soldiers Lee had in order that they might be fed. The reply was 25,000, and the Union commander ordered rations for Lee's men and Federal prisoners.

Again, Grant commented on his appearance, stating that the news of the negotiations came so fast he had not had time to dress . . .

4 P.M. . . . Lee shook hands with Grant and left the room. Outside, Sergeant G. M. Tucker, the General's orderly, met him with the horses. Lee wearily mounted Traveller, and the two men rode out through the yard.

A few moments later, Grant stepped out on the porch and paused to light a cigar.

The war was over.

• • •

MEN

Men are what women marry. They have two hands, two feet, and sometimes two, but seldom more than one dollar or one idea at one particular time. Like Turkish cigarettes, they are all made of the same material; the only difference is that some are better disguised than others.

Generally speaking, they may be divided into three classes: Husbands, Bachelors, and Widowers. A Bachelor is an eligible man of obstinancy and entirely surrounded by suspicion. Husbands are of three types—Prizes, Surprises, and Consolation prizes.

It is a psychological marvel that a small, tender, soft, violet-scented woman enjoys kissing a big awkward, stubby-chinned, tobacco and bay rum smelling thing like a man.

If you flatter a man, you will frighten him to death. If you don't, you bore him to death. If you permit him to make love to you, he gets tired of you in the end, and if you don't, he gets tired of you in the beginning.

If you agree with him in everything you cease to interest him; if you argue with him on everything, you cease to charm him.

If you believe all he tells, he thinks you are a fool, and if you don't, he thinks you are a cynic.

If you wear gay colors, rouge, and a startling hat, he hesitates to take you out, but if you wear a little brown beret and a tailored suit, he takes you out and stares all evening at the women in the gay colors, rouge, and the startling hat.

If you join in the gayeties and approve of his drinking, he swears you are driving him to the devil. If you argue with him to give up his drinking, he vows you are a "snob" and too nice for him.

If you are the clinging vine type, he doubts you have a brain in your head, while if you are modern, advanced, and independent, he doubts that you have a heart.

If you are silly, he longs for a bright mate, but if you are brilliant, he longs for a playmate.

Man is just a "worm in the dust."

He comes along, wiggles around for a while, and finally, some "chicken" gets him.

—Anon.

* * *

TRUE, ONE — FALSE, ZERO

by Dave Anand

This article is primarily written for those who have hitherto had little association with computers. Special care was taken to present the basic information only and no attempt was made to make this presentation either involved or highly technical.

Electronic computers have been known to do strange and complicated things. They will predict presidential elections, spot high altitude weather conditions, predict the path of earth satellites, and work out complex problems. But, computers solve problems in their own language; therefore, a problem must be translated from the language convenient to human beings to that convenient to the computer.

The language used for problems to be solved is a mathematical statement of a decision the computer must make. This language is simple arithmetic and elementary choices, expressed in a coded numerical form. In order to put the problem in the required form, one must know in some detail the functions of the various parts of the computer and the precise manner in which orders are given to the machine.

A computer is essentially a black box that handles numbers. Numbers put into it are input numbers and when the computer has operated upon them they are output numbers. We say that a computer does different kinds of operations on the numbers, called the *arguments,* giving the *results*. The operations in a digital computer are actually variations of simple addition. It will only perform these operations if it is instructed to do so. For example, if $x + 3\ (y + 2)$ was desired, the computer would be instructed to form $y + 2$, multiply it by 3 and then add x. For all this to be carried out, the computer must have some sort of *control* or memory to remember all the instructions, and a computing unit that would do the actual operations.

Referring to the previous problem we see that the arguments x, y, 2, and 3 must be stored in the memory to be called from time to time and operated upon. The main purpose for having an internal memory is that the time involved for numbers to traverse back and forth from the memory is quite small. Fast computers take about one micro-second to transmit a number. The control actually has to interpret the instructions and then set-up signals that will tell the computing unit what to do. Essentially then, a control unit includes an instruction decoder and a signal generator.

The input numbers are stored in addresses that have numbers. Each address is given an identification number and is called a cell, location, box, or bucket. A common analogy is to compare the computer memory with pigeon holes in the Post Office. Pigeon holes have name plates on them which serve as a reference for identification. It is important to note that the name plate does not tell anything about the contents. The name "Smith" on the name plate does not tell where a letter came from or what it says. If you put a certain letter in the box labeled "Smith" you should be able to find that same letter, whatever it may be about, by going back to the pigeon hole marked "Smith."

The memory has two additional characteristics which unfortunately do not fit into our Post Office analogy.

First, a memory location can hold only one word at a time, and placing a word in a location automatically and finally destroys whatever was there previously. On the one hand, this means that there is no problem of making sure a location is empty before putting something there; on the other hand, it means that we must be sure a cell does not contain something we wish to keep before something else is put into it.

Second, it is possible to read a number out of the memory without destroying or removing it. It is though the postal clerk, instead of removing a letter, simply made a quick copy of it on another piece of paper.

(Please turn page)

Finally, we must mention that the arithmetic unit must temporarily store numbers in the process of its operation, and this is achieved by having some sort of a storage called an *accumulater*. This, then, completes the block diagram of a computer as shown in Figure 1.

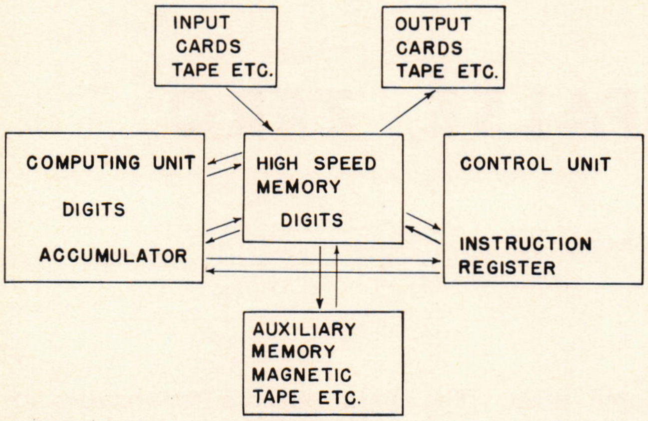


Figure 1

From the diagram, five distinct phases of operations can be enumerated:

1. Transmission of the first argument from the memory to accumulator.
2. Transmission of the second argument from the memory to accumulator.
3. Operation of the first and second arguments.
4. The result is transmitted from the accumulator to memory.
5. The address of the next instruction is ascertained and the cycle is repeated.

Numbers are essentially stored in the memory as voltage levels; in order to store different numbers, different voltage levels must be generated.

The number system used nowadays, the decimal system, was developed by the Hindus of ancient India. However, for the decimal number system, ten different voltage levels would have to be used, and this posed quite a problem. It was solved by using the binary system devised by the mathematician Von Leibnitz (1646-1716) although it appears to have been used in China some four thousand years ago. The binary system is simply counting on two fingers only! Numbers are represented by 1 and 0 and also by giving different place values to 0.

BINARY NUMBERS

2^3	2^2	2^1	2^0	
8	4	2	1	Decimal equivalent
			1	1
		1	0	2
		1	1	3
	1	0	0	4
	1	0	1	5
	1	1	0	6
	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12

A binary number is then composed of bits and the number of the bits is the length of the word. Since a number can now be denoted by 0-1 voltages pulses, the memory will memorize instructions in pulses. The speed of a computer is usually denoted by this pulse rate. When the instructions and the numbers are put in the binary form, they are punched on paper tape; different numbers are punched by variations of the position of holes. This tape is then fed into the computer, like feeding tape into a tape-recorder, and the computer "looks" at it. The sensing elements behind the tape are energized by light passing through the holes. By this method, the code on the tape is transformed to electrical pulses into the computer memory. To get an idea of speed, the paper tape transferring bits to the computer memory takes place at 2,000 bits per second while the magnetic tape is 100,000 bits per second.

A coded instruction consists of the instruction and the arguments that have to be operated upon. A typical form of instruction format consists of an instruction, first argument, second argument, address of the result, and the address of the next instruction. All this goes into one pigeon hole and it looks like the following.

43 110 010 111 100

The whole instruction could be read as follows: multiply (represented by 43) the argument in address 110 to that in address 010 and put the result in address 111 and then take the next instruction from address 100.

Now that the parts of a computer have been described, it would be helpful if a simple computer is described. The digital machine at The George Washington University is a slow-speed, single address computer with magnetic drum storage of 4094 numbers or instructions, each consisting of 24 binary digits, including sign (equivalent to about seven decimal digits). It is capable of performing 42 arithmetic, logical, transfer operations, and stop instructions through the use of 734 mechanical relays and 655 electronic tubes. Logical operations are those involving binary numbers; transfer operations pertain to shifting numbers from one part of the computer to another part. The input to the computer is a mechanically sensed, seven level teletype paper tape, and output may be on an electric typewriter or on punched tape.

To give an idea of the commercial problems that can be solved with a computer, an application by General Motors for analyzing the blower wheels of air conditioning units will be discussed.

The design of a blower was analyzed in two parts as shown in Figure 2 illustrating the fundamental steps in the computer program.

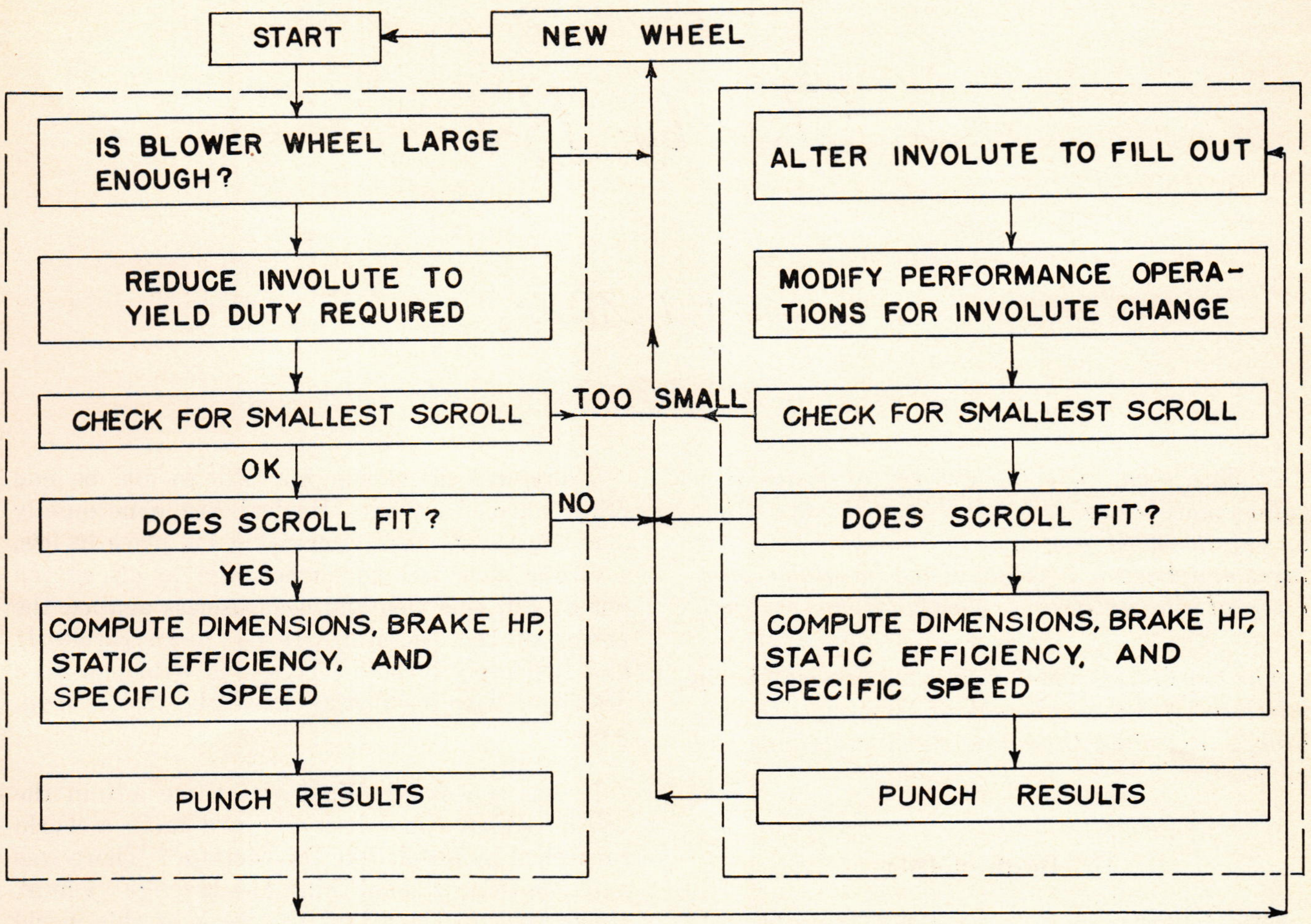


Figure 2

Flow Chart for Computing Dimensions of a Scroll Involute

The first part of the program pertained to calculating fan assemblies having the smallest possible scroll involute (casing of the blower) while maintaining a standard scroll width. The scrolls were modified in the first part of the program as shown, and the dimensions represent the maximum space allocated to the scroll.

In the second part of the computer program, the thinest scrolls feasible were calculated. In this case, the scroll was made to fill out the available face area of the air conditioning unit in either the x or y directions within the limits of the frame. For each blower wheel accepted by the computer as a possibility, complete scroll dimensions were calculated. Part of the information fed to the computer pertained to variations in air delivery with static pressure and the resulting change in fan brake horsepower. The information was then converted to equation form before being fed to the computer.

Computer applications are now becoming more widespread. One example is its use in medicine and medical problems. Along this line, Dr. Robert S. Ledley is writing a work entitled "The Application of Digital Computer to Biology and Medicine." In the future, there will be many new uses we have not even considered now; hence, engineers will probably find increasing demands on their knowledge of computers.

• • •

Two by Bob

with Bob Moore

It may seem that the subject of death is a rather macabre subject, but it is at the same time one of the most profound of subjects. For, like taxes and disease, it is one of the inevitable processes of life itself—the most profound subject.

The two stories which follow may seem entirely unrelated, but through each of them runs the unbroken, unending thread of man's ambitions and purpose.

The Death of Otto

Otto is dead; there is no doubt about it. Although I will never find his body, I know that there is no hope of his being alive. He was a martyr, a sacrifice to the Gods of Progress and Conformism. He had not fitted in with the Dictator's Grand Plan, and so it was inevitable that he would one day disappear from the face of the earth, absolutely and completely, and never be heard of again.

Still, although I knew it was inevitable, I was shocked when it had happened. One minute he was alive, a moving, feeling, thinking miracle of God's creation, and the next moment he was gone —completely disappeared.

It was unfair, unjust, that one person should have the absolute power of life and death. Life had been bearable with Otto here, but now that he was gone it was empty, useless. Otto had been my one friend, my one companion, and now that he was gone I no longer cared to eat or sleep. Until now I never realized how much I depended on his quiet, steady companionship.

There was no reason for Otto to die, he had never harmed anyone. He had just gone quietly about his way, steadily creating his place in life, a strong sure web to anchor him to his chosen home. But this web had been useless against the power of the Dictator! It had been carelessly and ruthlessly torn to pieces, and Otto had been destroyed with it—just as carelessly, just as ruthlessly.

It was senseless! What was there left in the world? What can I look forward to in a world controlled by people like the Dictator? There was only one thing I could think of—revenge! I must strike back to show that the weak of this world cannot be so callously treated, that even they can fight back.

But what can I do; I can't travel; all my life I have been confined to this place, and without official permission, I will probably never leave. I'm a prisoner, completely at the mercy of the caprices of the Dictator, completely powerless to act, and Otto is absolutely, irretrievably gone, leaving me alone, so alone!

Now the Dictator is watching me. Perhaps I'm to be next on the list of those who don't fit in with the Grand Plan of Progress and Conformism. Perhaps I'll be next to vanish and never be found! Now he's going to speak; now I'll know what is going to happen to me, whether I'll be crushed in the relentless juggernaut or be allowed to go on my harmless, inoffensive way.

He's speaking: "Now Johnny, I want you to stop this silly sulking and eat your dinner. I know your mother ran over Otto with the vacuum cleaner, but after all, he was only a spider!"

The Final Silence

There it is again! That same hesitating unsure sound. Everyone stops and turns to watch. There's no doubt about it, the feel of death is in the air all around us. The death noise sings through the air; I can hear the great, valiant heart striving to live; but it is slowly, inevitably losing the battle with time and age. The battle which can have only one conclusion . . . only one victor . . . only one victim!

But we won't let Death have it's victory easily, we'll fight it, for when Death wins, we'll all lose. We've staved off Death before, and we'll win again . . . we must win again!

We work, we pray, we fight, but we're losing. There it is again, the hesitation, the sudden stoppage of life, the silence—then life catches on again, one beat, two beats, three, four, and every man breathes again . . . we've won, we've won!

Then it happens! Sudden, unearthly silence hits each man's thoughts like a club. It has never been so silent before. Each man looks at his neighbor, then looks away because he cannot bear the look of bitter despair, of utter resignation which he sees.

After all we've been through, after all we've given to the fight, we've lost; we're through! Suddenly, as if by signal, everyone turns to go. In the space of a breath, the scene is vacant of any living thing. Death reigns supreme and alone over a scene of complete desolation and despair.

As I leave, I turn and look back to the spot where so many of us have fought for so long to preserve our way of life. At least that's the way it seems, but after the shock wears away, it won't be so bad. Man's instinct for self-preservation is too strong; man can't give up no matter how great the blow.

It's all over; for almost two years we've fought this battle knowing that to lose meant that we would have to begin anew as if this part of our life had never existed. We had fought, and we had lost.

It's no use to try to change the old Miller's mind again. The mine has been producing low grade ore for too long. His decision to close it as soon as the crushing mill became useless is unshakeable. It has happened! The death of the great, cumbersome, old-fashioned steam engine which was the heart of the mill; it has sounded the death knell of Silver Bend, Nevada. Without the mine the town will die, the people will leave, and one more ghost town will stand to mark the trail of man's progress.

It's almost dark now. We've all been packed and ready to leave for weeks, and it took only half a day to clear the town. Everyone streamed through the pass and out into the foothills beyond toward the unfriendly, unfamiliar world that exists there.

I'm the last to leave. From the high point of the pass I can look back and see the entire valley as if it were all on a great painting in some museum. I'm leaving my birthplace; but at the thought of it, I feel as though a great weight has been lifted from my shoulders. At last the long wait, the great dread is over. There's no longer any need to stay. Now I can leave this valley where the grim spectre of Death has threatened for so long. The valley is a grim sight but a peaceful one after so many years of turmoil.

It has been returned to nature once more; Nature will heal its wounds.

For on this small rock world of ours,
This is the fate of all of man;
To struggle hard to shape his ways,
To work and strive to breach the maze;
Then after giving life his best,
To turn his tiller to the West!

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WIND TUNNEL FACILITIES AT NOL

by John W. Roberts, Jr.

The Naval Ordnance Laboratory at White Oak, Maryland just recently celebrated its 10th anniversary. In January, 1949, the Laboratory was dedicated upon the completion of the administration building at its new location. Now the Laboratory has a physical plant with a replacement value of $50 million. The military and civilian personnel at NOL total 3,000, including 1,000 scientists and engineers. The Laboratory has a large aeroballistic research center with supersonic and hypersonic wind tunnels, shock-tube tunnels, and ballistic free-flight ranges. The aeroballistic facilities were recently enlarged at the cost of approximately $4 million. Task assignments include pure research, developmental research, design, and weapon evaluation involving problems in physics; aerodynamics; chemistry; and mechanical, electrical, and electronic engineering. Although it is still the principal mine development center of the Navy, the Laboratory does a considerable amount of work in aerodynamics and in other areas.

Two supersonic wind tunnels, originally used by the Germans to obtain aerodynamic data for the design of the V-1 and V-2 missiles are now at NOL. The U. S. Army took possession of these wind tunnels in May, 1945. In July of the same year, the Joint Chiefs of Staff awarded this equipment to the Navy. The two wind tunnels were then dismantled, shipped, and installed at NOL and are now called supersonic Tunnel No. 1 and Supersonic Tunnel No. 2.

Tunnel 1 is a German design and operates intermittently over a Mach number range from 0.2 to 5, including the transonic range. Maximum running time is between 40 and 60 seconds. Atmospheric air is dried and passed through a nozzle of the desired Mach number. The air is finally exhausted into a 52-foot-diameter sphere which can be evacuated to a pressure of 1/100 atmosphere. This tunnel is primarily used for measuring force moments which act on a missile model.

Tunnel 2 is also a German design and operates continuously over a Mach number range from 0.2 to 5, including the transonic range. A 12,000-horsepower compressor plant supplies air to the nozzle at pressures up to 3.5 atmospheres. The

air is dried just before it enters the nozzle. The continuous running feature of the plant makes it suitable for tests such as pressure distributions and heat-transfer investigations which require long equilibrium times.

(Please turn to page 43)

AN INFLATABLE ANTENNA

by Jack O'Neale

Several years ago the Army saw a need for a lightweight, easily portable antenna. During the summer of 1957, the firm of Jansky and Bailey, Incorporated was awarded a contract to study the feasibility of such a project, and if feasible, to develope it. The frequency range had to extend from 100 kilocycles to 2 megacycles, and the structure was required to be capable of withstanding severe environmental conditions.

The true intent of this project is clarified by quoting a section from the first progress report. "The complete unit must be capable of being erected in not over one hour by two men, shall not weigh over 500 pounds, and be able to withstand severe environmental conditions."

Since very little work had been done on the type of system described, this problem was attacked by resorting to the basis of all engineering: the theoretical analysis.

The problem was divided into two general parts—the electrical and the structural, although these parts were not altogether independent. The shape of the structure was governed by the antenna configuration, while the choice of antenna configuration was limited by structural considerations.

This article will deal mainly with the structural and mechanical problems encountered.

Based on a theoretical analysis and the results of model tests, the folded unipole type of antenna was selected. The first problem which had to be resolved was the design of a structure meeting the requirement of extremely light weight while maintaining its rigidity. This problem led to the study of two basic kinds of structures: inflatable and non-inflatable. Non-inflatable structures were rejected at a very early date because they either could not meet the requirements of light weight, or were not capable of withstanding high wind loads.

The rejection of non-inflatable structures opened the door for study into the little explored field of inflated bodies. The investigation began by analyzing the stability of an inflated cantilever beam, and comparing the results obtained from experimental tests on various models and with results which had been published previously by a university. Although the two sets of theoretical equations did not agree, the experimental data verified the equations developed for this project.

In order to calculate the loads which would be placed on the antenna, wind tunnel tests were made to determine the actual drag coefficients of several possible tower shapes. Knowledge of the drag coefficient allowed the development of relations predicating the effects of various wind loads. Since the stability of an inflated structure is a function of the inflation pressure, a series of "critical" pressures were calculated. Each of these pressures is dependent on a wind load which creates an overturning force applied at the centroid of the antenna.

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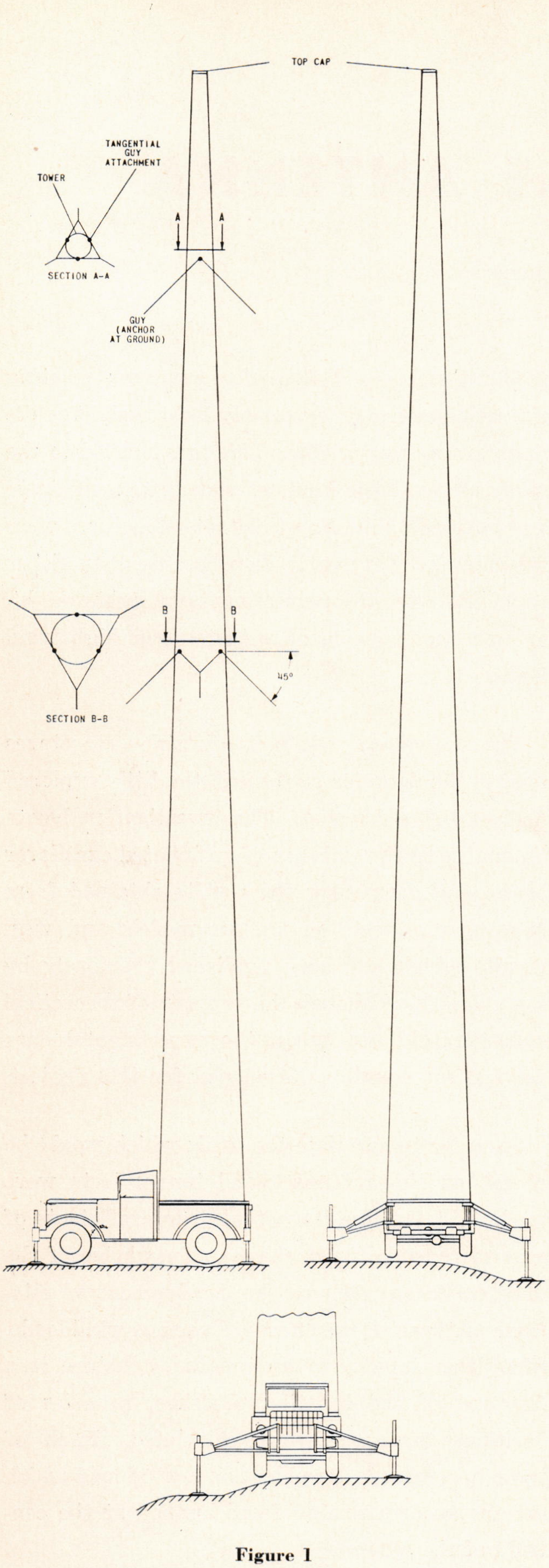

Figure 1

The next serious problem encountered was that of structural vibration. During wind tests on a model, it was observed that vibration occurred at a certain wind velocity. It was found that vortices were formed alternately on the sides of the tower which set up a pair of alternating forces acting perpendicular to the direction of wind velocity. When the frequency of these forces equalled the natural frequency of the structure, excessive vibration or possibly failure of the tower might occur. Because the actual tower size and shape had not yet been determined, this problem was not pursued further at the time.

A more complete study of the problems of stability was made, and the results were most interesting. It was learned that the stability of the structure was a function of the inflation pressure, and the base diameter and was independent of the tower shape. However, the drag forces caused by the wind loads were known to be a dependent on the frontal area of the tower, leading to a question concerning loads on the antenna. It was later found that the vertical force which can be supported by the structure is determined by the internal pressure and the area of the top. Examining these criteria it was concluded the optimum tower shape was one that incorporated a large base and a minimum frontal area with a top large enough to support the required vertical loads. Based on these facts, the shape chosen was that of a frustrum of a cone.

On the basis of electrical and structural considerations, it was decided that the antenna should have a height of between 80 and 100 feet, although this decision caused speculation regarding the weight and handling limitations placed on this project. After a study of the problem, it was found not to be feasible to attempt to handle a structure of this size. This led to the suggestion that the structure, complete with all appurtenances, be mounted "permanently" on a standard 3/4 ton, 4x4, Army weapons carrier.

The Signal Corps decided that the suggestion had merit and allowed the project to be continued accordingly; therefore, the weight limitation was raised to 1500 pounds. The time limit for erection was retained, however, but an emergency time limit for mobilization was set arbitarily at two minutes. The stability considerations previously mentioned led to the selection of the minimum height, 80 feet, and the base diameter, limited by the size of the truck bed, was set at 6 feet. The consideration of vertical loads, together with the necessity of minimizing the frontal area, determined a top diameter of one foot. Figure 1 is a preliminary sketch showing the antenna installed on the truck.

After determining the tower shape, it was possible to analyze the structure to ascertain the natural frequency of vibration, and it was found that the natural frequency corresponded to a wind velocity between 5 and 13 miles per hour. At these velocities, the forces created by the vortices were not sufficient to cause excessive vibration or failure of the antenna.

With the tower mounted on the truck, however, the question of stability became more critical. A system of outriggers and jacks were designed to lift the vehicle off the ground. Figure 1 also shows one of the earlier outriggers studied. Using this system, it was calculated that the tower would be stable in winds up to 40 miles per hour. But a system of guy wires, added later, enabled the structure to withstand winds in excess of 80 miles per hour.

The antenna structure, when completed in the summer of 1959, will be constructed of rayon coated with neoprene because of its flexibility and air retaining characteristics. Flexibility became one of the main considerations due to the method of erecting the tower.

Because of the possibility of operating in confined spaces, the structure is capable of rising and retracting vertically. Figure 2 shows the tower in several stages of erection. The method used to erect the tower requires that the pressure inside the structure be accurately controlled, since a low pressure would allow the antenna to buckle under wind loads. Therefore, a system had to be devised which would maintain the proper pressure inside the tower during erection. This system measures the antenna height and inflation pressure continuously while controlling the speed with which the tower is raised.

When the tower was retracted, a similar problem was encountered. The air must be withdrawn at the proper rate or else the antenna would either collapse, or the winch will not be capable of pulling it down. For this reason, the control system used during retraction operates a variable orifice that allows the proper amount of air to

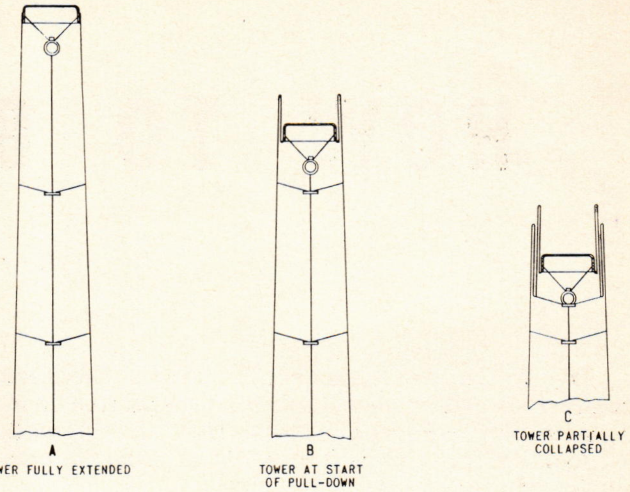

Figure 2

escape for any given tower position. Although the maximum inflation pressure is only 3.6 psi, retraction pressures in excess of 3500 pounds have been calculated.

Because of the portability of this antenna, a new type of electrical ground also had to be devised. It, too, had to meet the requirements of light weight, ease of installation and recovery, and have the electrical characteristics inherent in ground systems. The system devised consisted of eight 100 foot strips of aluminum foil, laminated in mylar, and radiating from a central connection. These strips are laid on the ground and provide a capacitive coupling to the earth. Each strip is 12 inches wide, 0.0034 inches thick, and can withstand a maximum current density of 79,000 amperes per square inch.

The radiating elements on the antenna proper are also made up of laminated aluminum foil; four of them are located around the tower. The radiation pattern is nearly circular at high frequencies, and, although scalloped at lower frequencies, it does not have any deep nulls.

At the present time the preliminary design from which the prototype will be built is being carried out. It is hoped that this first antenna will be completed and tested during the summer.

(Sketches and information, courtesy of Jansky and Bailey, Inc. Wash., D.C.)

* * *

HOW TO BUY A HOME

by Jean Payne

Are you a "wall-knocker"? That's the term many real estate men apply to prospective home buyers who, ignorant of what they should really be looking for, thump the walls of a house curiously, hoping to hear some clue.

Like "tire-kickers" among used car salesmen, and "leather-sniffers" in a whole variety of fields, "wall-knockers" rarely get as much value as they should. They shop for a home on Saturday, but forget to find out whether that quiet, shady lane is a truck route on weekdays. They admire a pretty lawn while shopping in summer, but forget to ask about the presence of insulation so necessary for winter. They do their hunting on dry, blue-sky days—and fail to look for the high-water marks on the basement walls.

"Buying a home is like proposing marriage," says housing expert Aubrey M. Callis of American Smelting and Refining Company, a major producer of such metals as copper, brass, and lead which are widely used in home construction. "If you're not careful, a slick coat of paint may dazzle you out of looking for honest structural soundness. Many people forget all about the attic."

Let's state a few of the points you should keep in mind when looking for a home.

Keep Records—Lists are an invaluable house-hunting aid. Before you shop, write down all the features your new house and neighborhood must have; then list those you'd like to find if you can.

While looking at prospective homes, have one member of the family jot down the good and bad points of each house you see. That way, you're less likely to request a second look at a house that left you cold first time around.

Easy-to-Spot Features—These are sometimes so obvious that no one thinks to check them, yet a house that lacks these features can be a king-size headache for years to come.

1. Exterior: Is the siding solid, the roofing tight and flat? Is paint free of peels, blisters and, "alligatoring"? A negative answer might mean a leak in the rain drainage system. Rain gutters and spouts should lead to dry wells (underground beds of rock and gravel for dispersion) at least 15 feet from the house. You can test the downspout by inserting a hose nozzle and running water down it for five minutes; none should back up.

2. Layout and Room Design: It's faulty if you must walk through the living room to get to any other room except the dining room. Is there a bath or lavatory on the ground floor? This is a consideration for any family—a must for those with small children. Is the kitchen large enough to provide adequate work space with at least one good-size window? Does each bedroom have cross-ventilation? Is there at least one closet for each person—plus coat, linen and broom closets and mildew-proof storage space? Experts say that no more than 10% of all floor space should be devoted to halls—anything more is pure waste.

3. Construction: Check basement walls for severe cracks, bulges, dampness, signs of flooding, a musty smell. Can it be aired out? If basement beams are free of rot, termites or carpenter ants, you should see no "sawdust traces", and you should not be able to sink a strong knife or ice-pick more than an inch or two into the beams. Watch out for long, deep plaster cracks around door and window frames, rain leakage stains on upstairs ceilings, walls, and around chimneys. Floors should be firm and level; you can test them with a 98 cent spirit level.

4. Wiring: Are there enough electrical outlets and circuits for the size of the house? Each fuse or circuit breaker in the basement panel board represents one circuit. Insist on a written guarantee that the house has at least a 60 amp electric service; 100 or even 200 amps are better. If the home is to be built, or if you're planning structural changes, call the telephone company for free advice on wiring. By running the wires behind walls, you'll avoid excessive exposed wiring. Consider having two or more outlets in each telephone room; that way, you can make future furniture shifts without requiring a major telephone installation visit.

5. Heating equipment: Is it suitable to the size of the house? Many new homes include two small heaters in lieu of one larger one. The "double header" gives a more even distribution of heat throughout the house.

6. Fixtures: Replacing worn-out ones can run into big money. Most reputable builders use solid brass bathroom fixtures, and you'll be better off and free of plumbing repair bills if you specify heavy-gauge brass. The extra cost is slight, and the fixture is much less likely to be bent out of shape.

(Please turn to page 44)

POINT OF ORDER

by Bill Franklin

Is a parent liable for the wrongdoings of his minor child? The answer to this question is not an easy one. Most people, however, think that parents of minor children are liable for *any* misdeed their children commit, and this certainly is not true. Take, for instance, the following case.

Wilson, the plaintiff, sued the defendent, Everett, for injuries sustained from acts of the defendent's daughter. It is averred that the minor child, Gay Everett, 8 years of age, "did willfully, deliberately, intentionally, and maliciously" swing a door "with such great force and violence against the plaintiff so that the middle finger on the plaintiff's left hand was caught in the door and a portion of said finger was caused to be instantly severed and fell to the floor. . . ."

It is an established rule that the mere fact of his paternity does not hold a parent liable for the tort of his minor child. But, there are exceptions to this: 1. Where he intrusts his child with an object which, because of lack of experience, judgment, or age, may become a source of danger to others. 2. Where the child is acting in the capacity of a servant or agent of the parent when a tortious act is committed. 3. Where the parent has knowledge of the child's wrongdoing, and, thereby, consents, directs, or sanctions it.

4. Where he fails to exercise parental control over his minor child, knowing that injury to another is a probable consequence.

Analyzing this case in the light of the above exceptions, the first three instances do not bear upon the circumstances here involved. Only the fourth exception could logically be assumed to apply here, and it was upon this category that the plaintiff relied.

The defendant's lawyer presented, as an example, a case involving similar circumstances. This concerned two boys who, while playing football in the street, collided with the plaintiff of that case, injuring her. The plaintiff claimed that absence of proper supervision, notwithstanding lack of evidence of unrestrained conduct in the past, rendered the parents liable for the acts of their minor children which might not have happened had adequate supervision been in force. Nevertheless, the court held that there was no evidence that either boy had ever played in the streets before or conducted himself in a disorderly manner; and that in order to attribute parental responsibility for misdeds of a minor child, the parents negligence must have some *specific relation to the act complained of,* and such was lacking in this case. . . .

In the light of such testimony, would you hold the parent responsible to the plaintiff for his daughter's tort?

* * *

The judgment was in favor of the defendent. One factor in the foregoing case stood out in the assessment of parental liability: whether the child had the habit of doing the particular wrongful act complained of. Nowhere in the testimony was it claimed that the child involved had a propensity to swing or slam doors at the hazard of those using them. The deed of a child which results in injury to another and is unrelated to any previous act or acts of the child, cannot be laid on the parents simply because the child happened to be born theirs. A wrongful act by an infant, however, which climaxes a course of conduct involving acts of a similar nature, may result in parental liability. A deed brought on by a totally unexpected reaction to a particular situation could not have been foretold or averted and hence could not render the parents responsible.

For this reason, the injury claimed to be sustained by the plaintiff could not be considered a natural and probable consequence of parental neglect.

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THE HUMAN BODY IN SPACE

by Woody Everett

From the beginning of time to the early 20th century, man has lived in an environment especially designed for him. In this environment all the necessities of life were provided with such abundance that man himself hardly recognized what his necessities were. The air around him was made up of 78% nitrogen, 21% oxygen, and 1% other gases, and the important breathing element of air, oxygen, was present in such quantities that any type of artificial breather was unnecessary. The very air that man breathed weighed 14.7 pounds per square inch and extended upward for a distance of about 100 miles. Since the internal pressure of his body was also 14.7 pounds per square inch, there was no danger of man's internal organs either bursting because of a relatively higher internal pressure, or collapsing because of a relatively higher external pressure. The air that man breathed formed a protective "armor", the atmosphere, which deflected, diffracted, and absorbed various rays of certain wavelengths emitted from the sun. This protective armor of atmosphere provided relatively satisfactory warmth and an abundance of breathable air.

This "ideal" state was changed, however, during the developmental period of World War II. It was during this period that engineers and scientists discovered that aircraft flew more efficiently at high altitudes. The problem then became one involving human beings and their ability to adjust to conditions that were different from the conditions existing on the face of the earth. At first it was only necessary to provide the human pilots with some type of artificial breathing apparatus. This was due to the fact that flights were being made at altitudes up to 10,000 feet, and at that altitude there was not enough oxygen present in the air to provide the human being with the necessary quantity to survive. The problem of furnishing an artificial breather, however, was extremely slight compared to others encountered when higher flights became desirable.

The problem of constant pressure on the human body became acute as altitudes above 10,000 feet were attained. This seems only reasonable, since one would expect that in a column of air 100 miles high the pressure would decrease as the distance from the earth increased. By vast experimentation, it was soon discovered that one cubic foot of air at sea level and constant temperature and pressure would expand to two cubic feet at an altitude of 18,000 feet where the atmospheric pressure was 7.34 pounds per square inch; to four cubic feet at an altitude of 34,000 feet where the atmospheric pressure was 3.62 pounds per square inch; to 14.7 cubic inches at an altitude of 63,000 feet where the atmospheric pressure was one pound per square inch; and to 86.88 cubic inches at an altitude of 100,000 feet where the atmospheric pressure was only 0.167 pounds per square inch.

Just what did this difference in atmospheric pressure mean?

The first noticeable effect caused by the difference in atmospheric pressure involved a lack of oxygen in the bloodstream. At sea level oxygen is responsible for 21% of the atmospheric pressure or three pounds per square inch; at an altitude of 18,000 feet, oxygen pressure drops to 1.5 pounds per square inch. This oxygen pressure is not enough to force oxygen into the human body in sufficient amounts; in fact, at this pressure the oxygen saturation of red blood cells drops to 70% and is not enough to maintain normal consciousness. The result is blackout. And, of course, at higher altitudes the deficiency becomes more acute.

Another serious problem encountered at high altitudes was that of nitrogen absorption in the bloodstream. There is nothing unusual about absorbing nitrogen in the bloodstream, for this happens every time a human breathes. The nitrogen, however, doesn't stay in the bloodstream—some of it is absorbed by body tissues. As outside pressure increases, the nitrogen comes out of solution in the bloodstream and tissues and forms nitrogen bubbles. The formation of nitrogen bub-

bles inside the body causes decompression sickness ("bends"), which is very painful and may cause unconsciousness or even death.

Aside from the possibility of becoming unconscious from loss of oxygen or from the "bends", there are other acute problems associated with high altitude flying. The decrease in atmospheric pressure destroys the equilibrium between the external and internal forces on the body. Because the external forces are less than the internal body forces, the body organs begin to expand in size. If the outside pressure decreases enough, the internal pressure will be so much greater than the external pressure that the organs will burst.

The early solution to the high altitude flights (10,000 to 25,000 feet) was the pressure suit and the pressurized cabin. In the pressurized cabin it is possible for human beings to fly to altitudes up to 30,000 feet without the use of an oxygen mask or a pressure suit. The principle behind the pressurized cabin is a simple one: make the cabin of an aircraft exactly like sea level conditions. This is exactly what was done. The cabin of the aircraft was simulated to sea level conditions in order that man could approach the higher altitudes without using the bundlesome pressure suits and oxygen masks. The solution of a pressurized cabin, however, had its practical limitation. Before long it became evident that to design a pressurized cabin for all altitudes, a great deal of space must be allocated to bulky equipment. For flights at higher altitudes, it was more economical to utilize the pressure suit and the oxygen mask. The pressure suit simulated sea level conditions of pressure and the oxygen mask simulated sea level conditions of breathable air. In addition the pressure suit was designed to give maximum pressure support to the weaker parts of the body such as the respiratory system. The pressure suit, in effect, was a personalized pressure cabin.

The race to keep the human being safe when he ventured from his native habitat was not over. No sooner had the problems of high altitude flight been encountered than another serious problem presented itself—that of "g" forces. Now it was well known that a human being could endure any limit of speed as long as he was in a straight and level flight; the problem occurred when he tried to go up, down, or sideways. It was soon discovered that when a man flew toward the earth, he had less force upon him than when he was in level flight; similarly, when a man flew away from the earth, he had a greater force upon him than when he was in level flight. The reason for this is obvious—gravity. The cause of the increased forces upon a pilot when the plane was banked in a turn is also obvious—centripetal force. Centripetal force was something to be concerned about—especially in the smaller and more maneuverable fighter-type aircraft. After the problem was defined, a search for the solution culminated in the development of a "g-suit", providing pilots with maximum protection in the weaker areas of the body.

Enter: The Space Age

The problems encountered in the ordinary development of the airplane were minor indeed when compared to those presented by the Space Age. No longer is it possible to design and prepare equipment to be used at altitudes of from three to five miles and at speeds approaching the speed of sound. Now it is necessary and essential to prepare and develop equipment which will protect the human being at altitudes of several hundred miles and at speeds up to ten and twelve times the speed of sound. And only with the advanced knowledge obtained in the last few years can man prepare himself for extended forays into space.

With the aid of the knowledge obtained in the space probes of the past two years, scientists and engineers have been able to set up criteria of "musts" for human space travel, but it is generally agreed among the leading scientists and engineers that the only way to actually determine the needs of a space traveler is to put one into space and study the effects upon him. Scientists know that they must prepare a "spaceman" to withstand the initial launch and recovery g-forces along with the accompanying acceleration and deceleration. In order to prepare man for this phase of space flight, it has been necessary to test the limits of his endurance of g-forces by the use of centrifuges, spin tables, and rocket sleds. From this type of testing came valuable information concerning restraining, positioning, and protective gear against tremendous g-forces. It has been estimated by the Air Force that man will have to be able to withstand forces amounting to 9-10 times the force of gravity upon launch and re-entry, and the Air Force has developed protective devices to help man withstand these forces.

Problems that are still to be solved in connection with the space travel program are methods of increasing human tolerance to g-forces, limits of human performance during launch and reentry, development and testing of the capsule components, and escape during the launch and reentry phases of space flight. Also unsolved is the effects of thermal loads and tolerances during launch and recovery, and of temperature on humans. Studies on insulation and heat suits, temperature control methods, and weightlessness must be completed. Scientists must perfect environmental control, necessary monitoring devices, and protection from noise and vibration. The effects of cosmic rays on the human being, the ability of the human to perform effectively in a space vehicle capable of leaving the earth's gravitational field, and the psycho-physiological aspects of the space travel, are yet to be satisfactorily determined.

In order to obtain more information about the importance of g-forces, Colonel John P. Stapp,

USAF, made human acceleration and deceleration studies at Edwards Air Force Base from 1947 to 1951. Colonel Stapp, his associates, and many others who worked on the problem of g-forces have found that human subjects are able to withstand forces up to twelve times the force of gravity before becoming unconscious. They discovered some people are able to perform guidance functions with their fingers while being subjected to forces up to 8 g's.

The time element is of the utmost importance in tests such as these. For instance, it is necessary to determine how long a man can withstand forces of this magnitude and still be able to function properly when the forces are removed. Intermittent forces simulating those expected in three-stage missile propulsion have been applied to humans; the volunteers adjusted promptly to the sporadic exposures of these heavy forces. Much headway has been made in the study of g-forces during the past 12 years, but the fact remains that practically all of the useful information obtained was from simulated experiments involving human volunteers.

Lieutenant Colonel David B. Simons, USAF, in August, 1957, made a balloon flight to an altitude of 101,000 feet in order to study the effects of high altitude flight and cosmic radiation. Cosmic rays are actually the nuclei of atoms ranging from the light hydrogen atom up through heavier atoms such as iron. Since these cosmic rays are made up of the nuclei of the atoms containing only protons and neutrons, there are no negative charges connected with them. Therefore, it follows that the earth's magnetic field would deflect these particles. They are most numerous where the earth's magnetic field is the weakest and less numerous where the earth's magnetic field in the strongest. The theory that less cosmic rays were encountered around the polar regions than at the equatorial regions was projected from these observations. This theory was verified by measurements taken from orbiting satellites.

In the study of cosmic radiation, Simons, his associates, and others determined that cosmic radiation caused graying effects on white and black mice and genetic effects on various vegetable seeds. Since man has never taken a trip beyond the protective wreath of the earth's atmosphere, the effect of cosmic rays on a human being will be learned only after man has ventured into space.

The X-15

North American Aviation, Incorporated was given the contract to produce a vehicle which could be utilized in the exploring of the space boundary as a manned vehicle. The vehicle produced was the X-15, which at this time is undergoing glider flights in preparation for a space exploration probe. It is with the X-15 that the engineers and scientists hope to learn the essentials about manned space flight.

To record the information transmitted back from the X-15, a new type of tracking station was needed. In response to government specifications set down by the Air Force and the National Aeronautics and Space Administration, Electronics Engineering Company of California was given the prime contract. This station has become known as the High Range because it is located atop a 9,000 foot peak just outside of Ely, Nevada, beyond California's Death Valley. The radar equipment located at High Range is capable of spanning 24,000 square miles. It is over this area that the Air Force and the NASA has marked a 485 mile by 50 mile flyway that reaches to the boundary of space to test the X-15. With the detailed equipment located at High Range, the control room operators will know the details of the X-15 flights almost as well as the pilot of the plane. Initial plans call for the electronically questioning of the X-15 approximately 1000 times every one-tenth of a second. Of this large number of questions, 656 will be asked about the temperatures over the plane both inside and outside, 104 will be asked on the strains being put on the various surfaces and components, approximately 140 different places will be questioned concerning pressures, and instruments will report on 15 control positions inside the airplane.

Initial plans for the flights of the X-15 are this: a B-52 will take the X-15 up to an altitude of 38,000 feet and make the drop; the X-15 will immediately begin to climb in a semi-circular pattern until it reaches an altitude of approximately 35 miles. At this point it will taper off gradually until it covers the full 485 mile course, spiralling in for a landing. After several initial flights have been made successfully, the X-15 will begin to probe the re-entry problem. At this time the B-52 "mother" will take the ship on its range to approximately the 175 mile point; it will release the X-15, which will immediately begin to follow an optimum pattern of parabolic shape until it reaches the altitude of 100 miles; it will then follow the same parabolic path down, re-enter the atmosphere at an angle of approximately 67½ degrees, and flatten out its path to spiral in for a landing. The flight range begins at Wendover and ends at Edwards. The X-15 will largely test the present equipment available to the test pilots; however, new and improved equipment is expected to be forthcoming as a result of the tests.

The Air Force and the NASA has made great use of simulated tests in order to prepare pilots for space travel. It is believed that many of the tests are unnecessary because they have no basis in fact; however, tests are run on the pilots in accordance with the prevailing theories because there is always that possibility that the prevailing theory will be right. In the X-15 lies the hope of future space exploration because it will be the first manned craft to encounter the problems of simulated space flight and re-entry.

A major aspect of the space exploration program is the human factor involved in space travel, but there is the old adage that must be considered: advancement is accomplished only by doing.

• • •

TEST YOUR LOGIC

This exam was given to 200 engineers of a large electrical manufacturing firm to test their logic. The time limit was one hour. Would you like to try your hand?

A certain train is operated by Robinson, Smith, and Jones. They are fireman, engineer, and brakeman, but not respectively. On the train are three businessmen: Mr. Robinson, Mr. Smith and Mr. Jones. Notice the distinction between the train crew and the businessmen is that the latter names are preceded by "Mr.", so don't confuse them. Now, consider the following facts.

1. Mr. Robinson lives in Detroit.
2. The brakeman lives halfway between Chicago and Detroit.
3. Mr. Jones earns $4000 a year.
4. Smith beats the fireman at billards.
5. The brakeman's nearest neighbor, one of the passengers, earns three times as much as the brakeman.
6. The passenger whose name is the same as the brakeman's, lives in Chicago.

What is the engineer's name? All of the above facts are relevant and must be used in the solution. You have one hour to work, and when you get through, you can check the solution below. Don't peek now!

* * *

First of all, let's draw up a table. You may not have attacked the problem like this, but it's easier to explain.

Fireman	*Brakeman*	*Engineer*
Robinson	Robinson	Robinson
Smith	Smith	Smith
Jones	Jones	Jones

Each of the crew members could be any of the three names appearing under the above titles.

From item 4, we find that Smith beats the fireman at billards; therefore, Smith can't be the fireman. Under the column headed "Fireman" you can scratch Smith's name.

From item 6, we see that the passenger whose name is the same as the brakeman's lives in Chicago. But in item 1, we see that Mr. Robinson lives in Detroit—the brakeman's name can't be Robinson, so scratch Robinson from the list of names under the brakeman column.

Next, from item 5, we find the brakeman's nearest neighbor is one of the passengers and this passenger earns three times as much as the brakeman. Obviously, this neighbor can't be Mr. Jones, since Mr. Jones earns $4000 a year, and $4000 isn't divisible by three. Mr. Jones, therefore, can't be the brakeman's nearest neighbor. From item 2, notice that the brakeman lives halfway between Chicago and Detroit; hence, neither the person living in Detroit, nor the one living in Chicago can be a "nearest neighbor." We know, from item 1, that Mr. Robinson lives in Detroit. We just showed that Mr. Jones couldn't be the brakeman's nearest neighbor; hence, Mr. Smith must be the nearest neighbor. This being the case, the passenger living in Chicago must be Mr. Jones, and, from item 6, we see that the brakeman's name must then be Jones.

Under the columns headed Fireman and Engineer, we can now eliminate the name Jones.

If you have been scratching these names as we went along, you should now have remaining under the brakeman column the name Jones. Under the Fireman column, you also should have eliminated all but Robinson. This leaves Smith as the engineer. Logical, huh?

* * *

POEMS

THE THINKER

He walks and thinks in darkest night,
  In silence deep and undisturbed;
In blackness brightly pierced by light
  Of moon so full and silver bright.

He dwells on life, and death, and birth,
  And Man and beasts, and sky and earth;
He dwells on all within his scope,
  A false horizon of his hope.

Conclusions reached are sure and bright;
  His mind is sharp and clear tonight;
All things are clear to him alone;
  His mind is lulled by false dawn's light.

But then the day has come once more;
  The clearness of the night is gone,
And some still night not long from now,
  He'll once more wonder, *Why* and *How?*

Robert Milton Moore

THE SEA

I go to the sea,
  To the rockbound shore;
Where the winds blow free
  With the surf once more.

And the thunder roars
  As the waves climb high,
And I feel the wind
  From on awesome sky.

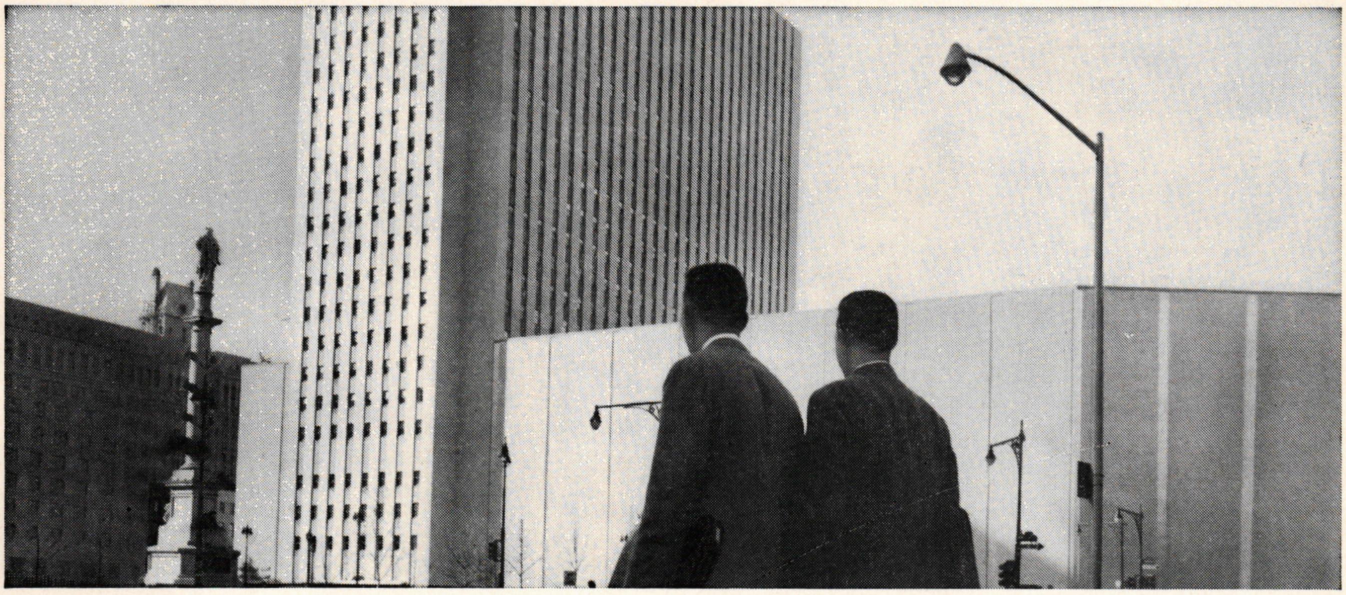
And I see the rocks
  As I knew they'd be,
Standing sternly straight
  In the maddened sea.

In the darkness deep
  'Mid the surf's great roar,
With the whistling wind
  And the rocks of yore.

And I soothe my pain,
  And I want no more—
For I've found my peace
  By the sea; by the shore.

Robert Milton Moore

New "post-grad" program helps engineers move ahead at Western Electric



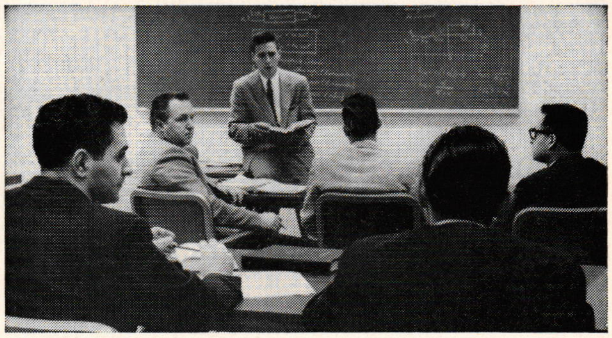
MANHATTAN'S COLISEUM TOWER building houses Western Electric's New York training center. Here, as in Chicago and Winston-Salem, N.C., Western Electric engineers participate in a training program that closely resembles a university graduate school.

Careers get off to a fast start—and keep on growing—at Western Electric.

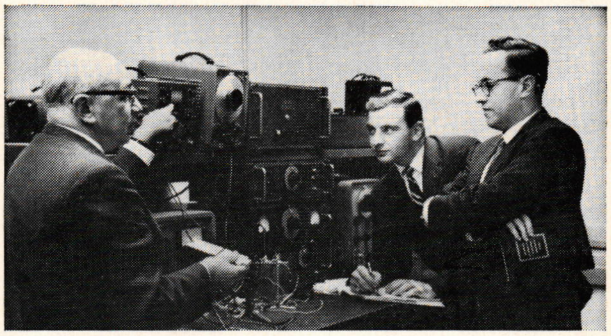
One big help is our new Graduate Engineering Training Program. This unique full-time, off-the-job study program starts soon after you join Western Electric . . . continues throughout your career. Students are offered courses in various fields including semiconductors, computers, feedback control systems, and problem solving techniques. What's more, they study methods for improving skills in communicating technical information and the art of getting ideas across.

You'll find the work at Western Electric stimulating, too. As manufacturing and supply unit of the Bell System, we pioneered in the production of the transistor, repeatered submarine cable, and the provision of microwave telephone and television facilities spanning the country. Engineering skills can't help developing—careers can't help prospering—in the lively, exciting technical climate at Western Electric.

Western Electric technical fields include mechanical, electrical, chemical, civil and industrial engineering, plus the physical sciences. For more information pick up a copy of "Consider a Career at Western Electric" from your Placement Officer. Or write College Relations, Room 200D, Western Electric Company, 195 Broadway, New York 7, N. Y. And sign up for a Western Electric interview when the Bell System Interviewing Team visits your campus.



CLASSROOM SESSION at one of the centers takes up the first part of the three-phase program, Introduction to Western Electric Engineering. During this initial nine-week training period, new engineers are provided with a better understanding of Western Electric engineering methods and technical practices.



TECHNICAL TALK often continues after class. The free and easy informality of the new Western Electric training program offers plenty of opportunity for the stimulating exchange of ideas.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Western Electric Graduate Engineering Training Centers located at Chicago, Winston-Salem, N. C., and New York. Principal manufacturing locations at Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Lincoln and Omaha, Neb.; Kansas City, Mo.; Columbus, Ohio; Oklahoma City, Okla.; Teletype Corporation, Chicago, Ill. and Little Rock, Ark. Also Western Electric Distribution Centers in 32 cities and installation headquarters in 16 cities. General headquarters: 195 Broadway, New York 7, New York.

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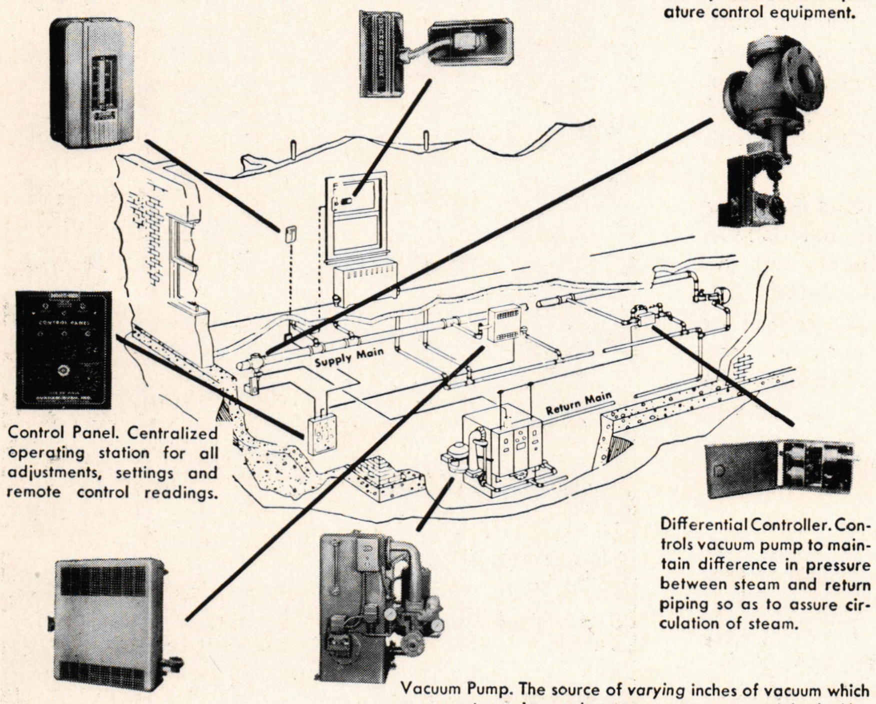
Room Resistance Thermometer. Serves as temperature limit control to prevent overheating and underheating.

Selector. Determines demand for heat by measuring the effect of outside weather conditions and inside building temperatures.

Control Valve. Regulates admission of steam into heating system, as called for by automatic temperature control equipment.



Control Panel. Centralized operating station for all adjustments, settings and remote control readings.

Differential Controller. Controls vacuum pump to maintain difference in pressure between steam and return piping so as to assure circulation of steam.

Heat Balancer. Measures rate of steam flow to system to balance heat input with heat demand.

Vacuum Pump. The source of *varying* inches of vacuum which assures steam in *varying* temperatures as required. Also produces necessary pressure differential between supply and return piping to assure quick, complete steam circulation and returns condensate from system to boilers.

You'll find Dunham Bush Vari-Vac, a precision temperature control system, in many well known buildings such as the New York City Housing Authority and Rockefeller Center's RCA Building.

Steam flows through Dunham-Bush Vari-Vac mains continuously, generally under vacuum, at pressures and temperatures that vary automatically (133° at 25″ of vacuum to 218° at 2 lb. pressure) and instantly with outside weather changes and inside heat losses. Vari-Vac effects many advantages including fuel saving and efficient operation.

Specifiers of heating, air conditioning, refrigeration and heat transfer products depend on Dunham-Bush for complete product lines and "one source—one responsibility".

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SALES OFFICES LOCATED IN PRINCIPAL CITIES

Ad Directory

WIND TUNNEL

(Continued from page 28)

Both tunnels are fitted with glass at the testing sections so that models may be viewed or photographed while they are being tested. A schlieren optical system is used for viewing shockwaves and other aerodynamic phenomena formed by models of nose cones, missile shapes, or airfoils.

Automatic readouts are incorporated with electric-resistance strain-gage balances so that forces on the model at different angles of pitch, yaw, and roll may be measured and recorded quickly. An IBM recorder tabulates the readings for immediate plotting and punches IBM cards for later data processing. This modern electronic data-taking and data-handling equipment enables the quick and accurate obtainment of data.

Tunnel No. 4 is a hypersonic tunnel of 10″ x 10″ cross section, operating in the Mach number range from 5 to 10. Nozzles of rectangular cross section are used for Mach numbers up to 8. Above 8, nozzles of circular cross section are used. The blowing time varies from 15 minutes to 5 hours. The supply pressure may be controlled from 1 to 50 atmospheres; likewise, the air temperature may be controlled from ambient to 1350°F to prevent liquefaction. The air is heated by a series of electric and indirect gas-fired combustion heaters which permit this tunnel to operate at elevated temperatures.

A new and larger hypersonic tunnel of 20″ x 20″ cross section, presently under construction, is designated Hypersonic Tunnel No. 8. This tunnel is to be in operation this spring. Tunnel 8 will operate in the Mach number range from 5 to 10 and will carry nozzles which are larger than those used in the other tunnels. Nozzles of rectangular cross section will be used for Mach numbers up to 8. Above that, nozzles of circular cross section will be used. Blowing time will vary from 1.5 minutes to continuous, depending on the test Mach number and the supply pressure. The supply pressure will vary from 10 to 150 atmospheres and the temperature required to prevent air liquefaction will vary from 160F° to 1500°F. The air will normally be heated to 1000°F by a storage heater and to 1500°F by an 2300 kw electric heater. The duration of a run at maximum temperatures and pressures will be limited by the amount of available air.

The storage heater was installed last summer and is shown in Figure 1. It weighs approximately 85 tons empty and is made of 5-inch cold-rolled steel with welded seams. Four cranes were used to erect it. As the cranes raised one end, the bottom end inched along on rollers. It was finally raised into the air and lowered into a pit. As it hung from the four crane hoists, the second half of the supporting structure was erected. It was then lowered and bolted into place and it now rests in the pit on two 30-inch I-beams.

The heater is filled with 120,000 lbs of small steel balls which are heated with gases of combus-

(Please turn to page 44)

WIND TUNNEL

(Continued from page 43)

tion. Air then flows through the heater where its temperature is raised to approximately 1000°F. If necessary, the air will be heated further by an electric furnace before it flows into the wind tunnel.

Plans are being made to improve the operating characteristics of Tunnel No. 8. A bottle storage pit is proposed to be installed which will provide 9.5 times more high-pressure air for continuous running. Also, additional heating equipment is intended to be installed which will permit extended operation at elevated temperatures.

The facilities at NOL provide for complete aerodynamic testing from subsonic through transonic and in supersonic and hypersonic regimes. Basic and applied research in aerodynamics is carried on in these facilities.

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HOW TO BUY A HOME

(Continued from page 32)

7. Yard: Is it large and private enough for your family's needs? Will the summer privacy provided by trees disappear with autumn's falling leaves? Shrubbery that's right up against an old house may harbor dangerous dampness or carpenter ants; check.

8. Garage: Is it big enough for your car with room for garden tools, a workshop, storage of screens or storm windows? How much snow-covered driveway will you have to shovel? Is there a covered walk to the house?

Those Vital "Invisibles"—These are the real quality guarantees, saving money in the long run and insuring that you won't have to tear the house apart at some future date for costly repairs.

1. Lumber: It should be seasoned to provide anti-warp insurance—with one exception. Western pine, which grows on high mountains, where the moisture load is not heavy, tends to equalize its moisture content with the surrounding atmosphere. It's okay to build with such lumber. But southern and northeastern pine should be kiln-dried.

2. Soil pipes: These are located underground and you probably will never see them, but they are very important to you. They provide the "exit" for your plumbing system; that is, they carry drainage from home to sewer. Because they are constantly in use, it makes sense that they should be of the very best material. Although soil pipe is avilable in several materials, copper, cast iron, galvanized iron and clay, your best bet is copper; it can't corrode or crack.

3. Shower stall: These days, almost all are gleaming invitations to a soothing soak, but there's more to a good tub than meets the eyes. A very important consideration is the kind of material used under the base of the stall. Plastic and paper, sometimes used, do not form a firm bond between the tile and base area. A lead pan under the shower floor, however, provides a trouble-free seal. The $11 extra cost may save you over $100 in repair bills. If you're house shopping, find out what's being used. If you're building, specify lead.

4. Attic openings: They should provide sufficient circulation to eliminate moisture condensation inside. If they don't, accumulated moisture will attack wood, warp and perhaps even rot it. The usual fault is too little ventilation, not too much.

5. Insulation: It may be worth its weight in fuel bills—if it's the right sort. If it isn't, you could lose thousands of dollars over a period of twenty or thirty years in lost heat. Sheep's wool and animal hair have good insulating qualities, but they are relatively expensive and need treatment against moths and other insects. Straw, excelsior and sawdust could be fire hazards. Best bet: asbestos, which is fireproof and inexpensive.

Be sure to find out not only what type of insulation you're getting, but also how much of it. Roof only? Roof and walls? Lower floors only?

Everyone has been in $10,000 homes that looked better, even "felt" better than homes costing almost twice as much. The odds are that the reason was careful attention to the above details. If you want to buy a bargain home, you can't afford to be a "wall-knocker".

• • •

SLIPSTICK SLAPSTICK

The distinguished speaker turned to the chairman of the meeting and asked for a glass of water.

"To drink?" inquired the chairman.

"Oh, no," replied the speaker with a sweet smile, "I do a high dive."

Arts Student: "I have a splinter in my finger."

Engineer: "Been scratching your head?"

Sweet young thing: "Am I the first girl you ever kissed?"

Engineer: "Now that you mention it, you do look familiar.

Several engineers were exchanging stories about their experiences with the opposite sex.

"Aw," sniffed one. "Girls are a dime a dozen!"

"Gee," sighed a Bus. Ad., who had remained silent until now, "and all this time I've been buying jelly beans!"

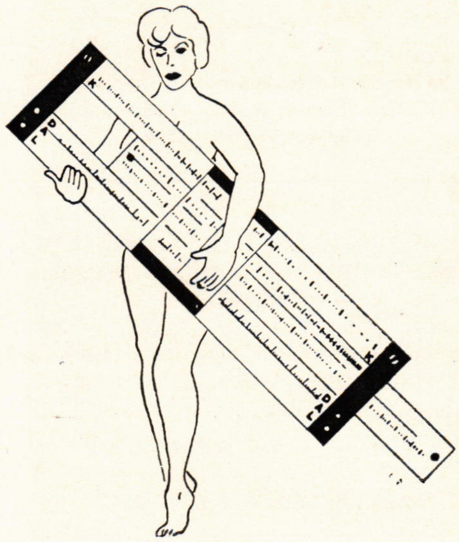
Bus. Ad.: "Gimme two eggs."

Waiter: "How do you want them cooked?"

Bus. Ad: "Is there any difference in price?"

Waiter: "Nope, same price any way you take them."

Bus. Ad.: "Good; I'd like them cooked with a slice of ham."



After a rather wild date with a charming young lady, her escort, a bit worried, asked: "Do you tell your mother everything you do?"

"Certainly not!" she exclaimed. "Mother doesn't care—it's my husband who's so inquisitive."

An engineer friend of ours has described a pink elephant as a beast of bourbon.

Prof.: "This liquid turns blue if your unknown is basic, and it turns red if the unknown is acidic."

Ch. E.: "Sorry, but I'm color blind. Have you anything with a bell on it?"

Connect 20,000 volts across a pint of whiskey. If the liquid jumps, the product is poor. If the current causes a precipitation of lye, tin arsenic, and iron slag, the whiskey is fair. But if the liquor chases the current back into the generator, you've got good stuff, brother!

What can a bird do that seven out of ten people cannot?
Make a small deposit on a new car.

A group of civilians was touring a battleship when the guide paused before a bronze plate set into the deck and said reverently, "And this is where our gallant captain fell."
"Well, no wonder," remarked a little old lady; "I nearly tripped over the damn thing myself."

"More people are caused by accidents than any other way."—From a speech on safety given in New York.

A farmer and a professor were sharing a seat on a train. It was getting lonesome so the farmer started a conversation and they soon became a friendly pair.
"Let's have a game of riddles to pass the time," said the professor; "if I have a riddle that you can't guess, you give me one dollar or vice versa."
"Okay," agreed the farmer, "but since you are better educated than I am, do you mind if I give you only fifty cents?"

"Fair enough," replied the professor. "You go first."

"Well, what animal has three legs walking and two legs flying?"

"Beats me. Here's your dollar. What's the answer?"

"I don't know either," answered the farmer. "Here's your fifty cents."

A report being circulated in Munich has it that a thief recently broke into the chief propaganda office in the Russian Sector of Germany and made off with the complete results of next year's elections.

A lobbyist who was opposing a large appropriation for a state college approached a legislator who boasted of his self-education.

"Do you realize," asked the portly lobbyist gravely, "that up at the College men and women students have to use the same curriculum?"

The legislator looked startled.

"And that men and women often matriculate together?"

"No!"

The lobbyist came closer and whispered, "and a young lady student can be forced to show a male professor her thesis?"

"I won't vote them a damn cent!" bellowed the legislator.

She: "Why did you take up the piano?"

He: "My beer kept sliding off the violin."

Golf is a game in which a ball $1\frac{1}{2}$ inches in diameter is place don another ball 8,000 miles in diameter. The object of the game is to hit the small ball and not the big one.

Student Nurse: "Every time I bend over to listen to his heart his pulse rate goes up alarmingly. What should I do?"

Intern: "Button your collar."

Englishman No. 1: "Terribly sorry you buried your wife the other day."

Englishman No. 2: "Had to—dead, you know."

A kind-hearted old gentleman saw a little boy trying to reach a doorbell. He rang the bell for the tyke, then asked, "What now, little man?"

"Run like hell," said the little boy. "That's what I'm gonna do."

"How much is four times twelve, Jimmy?" asked the teacher.

"Forty-eight," replied Jimmy.

"Correct, that's very good," approved the teacher.

"Good, hell," screamed little Jimmy; "that's perfect!"

The scene is a train compartment in Romania. The characters :a Russian officer, a Romanian, an old lady, and an attractive girl. The train enters a tunnel. The passengers hear first a kiss, then a vigorous slap.

The old lady thinks: "What a good girl she is, such good manners, such fine moral character!"

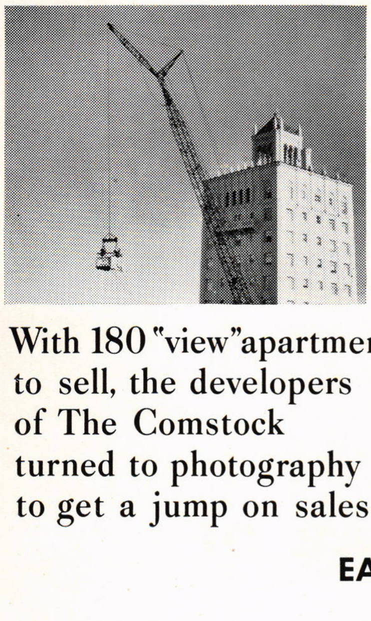
The girl thinks: "Isn't it odd that the Russian tried to kiss the old lady and not me?"

The Russian thinks: "That Romanian is a smart fellow: he steals a kiss and I get slapped."

The Romanian thinks: "Am I a smart fellow! I kiss the back of my hand, hit a Russian officer, and get away with it."

Though the building is not yet built, this is a view from one of the apartments.

How to look out a window before the building is up



With 180 "view" apartments to sell, the developers of The Comstock turned to photography to get a jump on sales

A feature of The Comstock, San Francisco's new co-operative apartments on top of Nob Hill, will be the spectacular panoramic views of the Bay area from their picture windows.

How could these views be spread before prospective buyers—before the building was up? The developers, Albert-Lovett Co., found the answer in photography. From a gondola suspended from a crane, color photos were made from the positions of the future apartments. Now, the sales representative not only points out the location of a possible apartment on a scale model, but shows you the view from your window as well.

Photography rates high as a master salesman. It rates high in other business and industry tasks, too. The research laboratory, the production line, the quality control department and the office all get work done better and faster with photography on the job.

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